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The Engineer.

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VOL. CLIII.—No. 3975] LONDON: FRIDAY EVENING, MARCH 18, 1932 [PRICE 1/ WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

Ministry of Transport.

ARTERIAL ROADS—GREATER LONDON.
EAST HAM AND BARKING BY-PASS A. 118.
EXPERIMENTAL SECTION.
CARRIAGEWAY, KERBING, FOOTWAY, SURFACING, &c.

The Minister is prepared to receive TENDERS for the CARRYING OUT of the above-mentioned WORKS, within the County Boroughs of East Ham and West Ham.

Forms of Tender, conditions of Tenders, conditions of contract, form of contract, bill of quantities and specification may be obtained from, and drawings may be inspected at the offices of the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, on and after the 21st March, 1932, upon payment of a deposit of £25.

This amount will be returned to the Tenderer if his Tender is a bona fide one and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.

Tenders on the official form, accompanied by a fully priced bill of quantities, and enclosed in a sealed envelope, endorsed "TENDER FOR ROAD WORKS, EAST HAM AND BARKING BY-PASS," must reach the undersigned by 10 a.m. on Thursday, the 7th April, 1932.

The Minister does not bind himself to accept the lowest or any Tender.

Dated this 16th day of March, 1932.

J. S. POOL GODSELL,
Assistant Secretary.

Roads Department. 8307

Corporation of Durban (Natal)

The Corporation of Durban (Natal) is prepared to receive TENDERS for the SUPPLY and DELIVERY f.o.b. of approximately—

THREE MILES CADMIUM COPPER CONDUCTOR for 33-kV Overhead Transmission Line, to be approved by the Consulting Engineers, Messrs. Merz and McLellan, 32, Victoria-street, Westminster, London, S.W. 1.

Specifications can be obtained from, and sealed and endorsed Tenders (in duplicate) must be delivered to, the undersigned on or before Wednesday, 30th March, 1932.

The lowest or any Tender will not necessarily be accepted.

By Order,
Messrs. WEBSTER, STEEL and CO.,
9, St. Helen's-place,
Bishopsgate, E.C. 2
8292 (Agents to the Durban Corporation).

Galloway Water Power Company.

TENDERS FOR CONTRACT No. 12.
OVERHEAD ELECTRIC TRAVELLING CRANES.

The Galloway Water Power Company invite TENDERS for the SUPPLY, DELIVERY and ERECTION of ONE 60-Ton OVERHEAD ELECTRIC TRAVELLING CRANE for their Tongland Power Station and ONE 50-Ton OVERHEAD ELECTRIC TRAVELLING CRANE for their Glenlee Power Station.

Copies of the specification and Tender form may be obtained from their offices on application to the undersigned on or after Monday, 21st March, 1932, on payment of a deposit of Two Guineas for the first copy and of One Guinea for each subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.

Tenders on the form supplied, endorsed "Tender for Contract No. 12," must be delivered to the offices of the company not later than Twelve Noon on Friday, 8th April, 1932.

The Company do not bind themselves to accept the lowest or any Tender.

(Sgd.) T. LAWRIE,
Secretary.

Galloway Water Power Company,
Queen's House,
Kingsway,
London, W.C. 2. 8290

Stockport Corporation Waterworks.

GOYT VALLEY SUPPLY—CONTRACT C.
TRUNK MAINS, HIGH-LEVEL SERVICE TANK, &c.

The Waterworks Committee invite TENDERS for the LAYING and JOINTING of CAST IRON PIPES, 30in. and 12in. in diameter, between the Goyt Valley, Whaley Bridge, and Higher Disley, and between Disley and High Lane. These mains extend altogether to a length of about 10 miles, partly along main roads and partly otherwise.

In addition to the above, the work will, besides various ancillaries, comprise two Intake Weirs and Aqueducts for the conveyance of water to a High-level Covered Service Tank to be constructed of concrete at Gyrn Clough, not far from the road between Goyt's Bridge and the Cat and Fiddle Inn.

Plans and drawings may be seen and specification and form of Tender obtained on application to Messrs. G. H. Hill and Sons (Manchester), 40, Kennedy-street, Manchester, upon the deposit of a CHEQUE for Five Guineas, which sum will be returned to the tenderer provided he shall have sent in a bona fide Tender, shall not have withdrawn the same, and shall have returned ALL the documents, including drawings, LENT to him.

A limited number of sets of drawings (uncoloured) will be LOANED to persons tendering, in priority of application, upon the receipt of Two Guineas, which sum will not be returned.

Sealed Tenders, endorsed "Goyt Valley Supply, Contract C," and addressed to "The Chairman of the Waterworks Committee," must be delivered at the Waterworks Offices, Town Hall, Stockport, not later than Monday, the 11th day of April, 1932.

The Committee do not bind themselves to accept the lowest or any Tender.

FRANK KNOWLES,
Town Clerk.

Town Hall, Stockport,
15th March, 1932. 8293

TO DREDGING CONTRACTORS.

The Commissioners of Northern Lighthouses

invite TENDERS for the DREDGING of about 200 Cubic Yards of SILTING in the berth at their pier at Stromness. A rate per day to be quoted for hire of dredger and hopper, including crew, coals, insurance, dues, pilotage, and all other costs. Contractors to state the minimum sum for which they would undertake the work. Further particulars may be had on application to Mr. D. A. Stevenson, M. Inst. C.E., Engineer to the Commissioners, 84, George-street, Edinburgh. Tenders to be lodged with the undersigned, marked on outside of envelope "Tender for Dredging," not later than 10 a.m. on 31st March. The Commissioners do not bind themselves to accept the lowest or any Tender.

J. GLENCORSE WAKELIN,
Secretary.

84, George-street, Edinburgh,
14th March, 1932. 8282

The Engineer

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PUBLIC NOTICES.

International Tin Research and Development Fund.

APPLICATIONS are INVITED for the POST of DIRECTOR under the General Council of Control of the above Fund. The Director will be required to Organise and Direct International Research and Development, with the object of expanding the existing markets for Tin, and of finding new uses for the metal. Candidates should possess high scientific attainments, have experience of metallurgical research, and knowledge of research developments abroad in this field. Administrative capacity and organising ability are essential.

A minimum salary of £1500 a year is contemplated; the actual salary will depend upon the experience and qualifications of the successful applicant. It is intended that the appointment will be made as from the 1st June, 1932.

Applications should be made in writing to Sir JOHN CAMPBELL, 2, Richmond-terrace, London, S.W. 1. 8286

Sevenoaks Waterworks Company.

APPOINTMENT OF ENGINEER.

The Directors invite APPLICATIONS for the above APPOINTMENT, at a commencing salary of £400 per annum. Applicants must be under 40 years of age.

Previous service with a water undertaking is essential, and applicants must have a thorough knowledge of and practical experience with Machinery, Main Laying, &c.

Applications (stating age, qualifications, experience, present and previous appointments, and accompanied by copies of not more than three recent testimonials), must be delivered to the undersigned on or before Wednesday, the 23rd March, 1932.

F. VALLINS,
Secretary.

Oak-lane,
Sevenoaks.
8th March, 1932. 8254

PUBLIC NOTICES.

Urban District Council of Newry.

TENDERS FOR STONE BREAKER.

The Urban District Council of Newry invite TENDERS for the SUPPLY of a COMBINED STONE-BREAKING and GRANULATING PLANT.

Further particulars can be obtained on application to Mr. C. Blaney, Town Surveyor, Town Hall, Newry, to whom Tenders should be submitted on or before Thursday, 24th inst., endorsed "Tender for Stone Breaker."

The lowest or any Tender not necessarily accepted.

Dated this 15th day of March, 1932.

By Order,
W. M. CRONIN,
8299 Town Clerk.

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

WANTED, a CHIEF METALLURGIST for the Tata Iron and Steel Company, Jamshedpur, India. Applicant must be a fully qualified Metallurgist with not less than five years' experience of metallurgical work in a large iron and steel manufacturing plant. Salary Rs. 2000 to Rs. 2500 per month, according to qualifications.—Apply by letter only in the first instance, stating age, full particulars, and copies of testimonials, to Messrs. TATA, Ltd., Capel House, New Broad-street, London, E.C. 2. 8302 A

SITUATIONS OPEN (continued)

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with large Corporation in England or Sweden; British, Swedish, and German references. Will visit England for interview. 8305 B

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EASTER HOLIDAYS.

All Advertisements intended for the Classified Advertisement Section of March 25th issue must reach this office not later than first post Wednesday, March 23rd.

28, ESSEX STREET, W.C. 2

The Engineer

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Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

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This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

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P2143 I

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A Seven-Day Journal

Welded Steel Structures.

SPEAKING on the occasion of the visit of structural engineers and others to the Walthamstow works of Murex Welding Processes, Ltd., for the purpose of inspecting the company's new welded steel-frame building, Mr. J. H. Humphreys, President of the British Steelwork Association, referred to the prospects of welded steel structures. In the steel industry, he said, great attention was paid to all developments which gave rise to economies without detriment to efficiency. Among the problems to which the steel industry was devoting attention was that of welding, and development in building construction was receiving the attention of the Department of Scientific and Industrial Research, in conjunction with the British Steelwork Association. In these days of high costs the most modern processes which promised an increase in efficiency had to receive full and careful consideration. It would, he thought, be generally agreed that welding had proved itself to be as efficient for many purposes as riveting, and when greater experience had been obtained in its application to steel structures, it would prove a formidable competitor to the older method of construction. It had to be remembered that the science of welding was not modern, in the sense of being recent and theoretical. It had been developed to a much greater extent abroad than in this country, not only in connection with the erection of steel-framed buildings and in the strengthening of bridges, but also in connection with such work as the construction of steel floors in accordance with the scheme developed by the American Institute of Steel Construction. Welding had, however, to break down conservatism in British building practice, and Murex Welding Processes, Ltd., was doing great pioneer work and rendering great service to the industry in demonstrating, in the construction of its own workshops, the practicability and economy of welded steel structures.

The Electrical Future of Britain.

THAT in the next two or three years this nation will have become the leading electrical country of the world, was the opinion expressed by Mr. Frank Hodges at the twenty-first annual dinner of the Birmingham Electric Club, held in Birmingham on Friday, March 11th. Great Britain's increase in electrical generation and consumption, he said, during the last five years was 34·9 per cent. In the United States it was 16·3 per cent.; in Germany 14·6 per cent.; in Canada 12·6 per cent.; and in Italy 21 per cent. The Central Electricity Board had practically completed the contract side of its work, and by the spring of 1933 it would have erected practically every tower and line from the North of Scotland to the West of Cornwall. The Board had placed contracts for the high-tension system representing £21,000,000, and not a penny had been spent in any other country. The sum of £8,000,000 had been spent on the standardisation of frequency. He firmly believed that the Board's achievements were only the preludes to the further electrical development of the country, and that in the next year or two it would become the leading electrical nation of the world. Mr. Alexander Ramsey, who gave the civic toast, said that he knew of no English borough that had contributed more than, or even as much as, had Birmingham to the industrial and political history of the country. There were many pessimists and crokers who spoke as if the country was hanging on to the fringe of the skirt of old-fashioned prosperity. But there were everywhere great communities which had not entered into production and consumption, and it only needed an appreciable step upward in the general culture of the whole world to make the manufacturing powers of the Western Hemisphere busier than they had ever been.

Reorganisation of Cammell Laird and Co.

THE annual report of Cammell Laird and Co., Ltd., which was published last Saturday, was accompanied by a circular describing details of a scheme of financial reconstruction which is to be considered by separate meetings of the stock and shareholders in London on March 23rd. The scheme provides for a reduction of the ordinary and preference shares and for the payment of the interest on debenture stock to be conditional on the necessary profits being earned. In return the debenture holders will be represented on the board of the company. Both the scheme itself and the reasons why the company finds reorganisation necessary are explained in the circular. When the company obtained considerable interests in the English Steel Corporation and the Metropolitan-Cammell Carriage, Wagon and Finance Company it became to a large extent a holding concern. Of the total assets, approximating to £6,000,000, more than £4,500,000 is represented by shares in the above-named and other companies. At the time these interests were obtained it was recognised that it was unlikely that any dividend would be obtained from these sources for some years until the process of reconstruction had been completed, but it was believed that the company's shipyard would be able to earn enough profit to pay debenture stock charges and depreciation. Both in 1929 and 1930 this expectation was realised, but the depression through which the country is now passing could not be foreseen, and when in the middle of the year it was possible to see that sufficient profits would not be earned, the board felt that prompt action must be taken.

Inspectors of Factories.

THE announcement is made by the Home Office that Mr. D. R. Wilson, one of his Majesty's Deputy Chief Inspectors of Factories, has been appointed his Majesty's Chief Inspector of Factories, in succession to Sir Gerald Bellhouse, who is to retire on April 3rd next, on attaining the age of sixty-five. Mr. G. Stevenson Taylor, one of his Majesty's Superintending Inspectors of Factories, will be promoted to the rank of his Majesty's Deputy Chief Inspector, in succession to Mr. D. R. Wilson. Sir Gerald Bellhouse has been Chief Inspector of Factories since 1922, and did valuable war work in connection with munition workers and the demobilisation of civil workers. He has specially interested himself in problems connected with juvenile employment, and has served on several Government Committees appointed to deal with such problems. The new Chief Inspector, Mr. D. R. Wilson, has for many years been the secretary of the Industrial Fatigue Research Board, and has also done important committee work on the humidity and ventilation of textile factories, and the lighting of factories and workshops. Mr. G. Stevenson Taylor, the new Deputy Chief Inspector, is an honoured member of the Institution of Mechanical Engineers, and has often spoken at Institution meetings in connection with matters relating to safety in industry. He has been closely associated with the formation and working of the Home Office Industrial Museum at Horseferry-road, Westminster.

The Reorganisation of the Royal Mail Group.

IN a Journal note last week we gave some particulars of the scheme of arrangement of the Royal Mail Steam Packet group of shipping companies, by which, it will be remembered, two operating companies are provided for. It is now stated that, taking into account the importance and the size of the fleets to be operated by the two concerns, it was considered advisable that the management of the two divisions should be placed under the direction of shipowners of the highest reputation and great experience. We understand that, subject to the unanimous desire of all interested parties, Sir Frederick Lewis, of Furness, Withy and Co., Ltd., and Mr. Richard Durning Holt, of Alfred Holt and Co., have consented to accept the chairmanships of the two new operating companies. By this arrangement Sir Frederick Lewis will direct the activities of the group, which, we suggested in our Journal note last week, would be named Royal Mail Lines, Ltd., while Mr. Holt will similarly control the Elder-Dempster group, of which the provisional title is Elder Dempster Shipping Lines, Ltd.

The Late Mr. J. W. Reed.

WE regret to have to announce the death, at his home in South Bolden, of Mr. Joseph William Reed, who was born in 1859. It was he that was responsible for the design of the first triple-expansion engine to be used in the British Navy. Mr. Reed was for some time manager of Fawcett, Preston and Co., Ltd., of Liverpool, and was there responsible for a very large amount, not only of marine, but also of general engineering work. Later he was general manager of the engineering department of Palmer's Shipbuilding and Iron Company, Ltd., of Jarrow-on-Tyne, and while there he reorganised and partly rebuilt the engine works. Mr. Reed is probably best known for his design of a type of water-tube boiler, of which about 170 have been fitted in destroyers, gunboats, and cruisers of the British Navy. He was also responsible for the design of a system of forced lubrication for torpedo-boat destroyer engines. Retiring just prior to 1914, he returned at the outbreak of war to become engineering manager of William Doxford and Sons' works, where he organised the department given up to war work and was responsible for work on a large number of destroyers and other vessels. Mr. Reed was a member of the Institution of Mechanical Engineers, the Institution of Naval Architects, and other societies and institutions, and a member of the Council of the North-East Coast Institution of Engineers and Shipbuilders. He was the author of many technical articles and one book, "The Development of the Modern Marine Engine," which was published in 1908.

Federation of British Industries.

AT a meeting of the Grand Council of the Federation of British Industries, held last week, Sir George Beharrel was nominated to succeed Sir James Lithgow as President of the Federation for the coming year. Sir George Beharrel was born at York in 1873 and educated at Almondbury and Leeds University. Leaving the University, he became assistant to the general manager of the North-Eastern Railway and later assistant goods manager and commercial agent. In this service he gained great knowledge of railways and commercial transport generally, and his work led up to a number of important appointments during the war. To begin with, he was made Director of Statistics and Requirements at the Ministry of Munitions, but after a short period he proceeded to France as Assistant Director-General of Transportation. At a later date he became Assistant Inspector of General Transportation for all the theatres of war with the rank of lieutenant-colonel. In 1917 he was awarded the D.S.O. Towards the end of the war he became Director of Statistics at the Admiralty. With the coming of peace he was attached to the Geddes Committee on National Expenditure in 1921 and 1922. Besides his work on this Committee Sir George was Director-General of Finance and Statistics at the Ministry of Transport. He was knighted in 1919. Outside his Government service he was for two years President of the Society of Motor Manufacturers and for one year of the India Rubber Manufacturers' Association. At the present day he is managing director of the Dunlop Rubber Company, Ltd., a director of Imperial Airways, and a Vice-President of the Federation of British Industries. Subject to confirmation of his nomination, Sir George will enter upon his new office some time next month.

A New Southern Railway Channel Island Steamer.

TO-DAY—Friday—the new Southern Railway steamer, "Isle of Sark," will make her inaugural run to the Channel Islands. Like her sister ships, the "Isle of Jersey" and "Isle of Guernsey," she has been designed and built by Denny Brothers, of Dumbarton, but the new ship embodies several noteworthy improvements. The hull form forward is of a modified Maierform type, which has been adopted with the object of reducing her resistance in calm weather and improving her sea-going qualities in stormy weather. In view of the heated discussion on the Maierform type of hull which took place at the Institution of Naval Architects' meeting this week, the performance of the "Isle of Sark" in service will be watched with interest. The machinery comprises Parsons geared turbines taking steam from the latest Yarrow water-tube boilers, and her builders have fitted a new type of propeller, which has been developed after extensive experimental work at the Dumbarton Tank. These propellers are stated to have given very satisfactory results during the recent extended trials of the ship. The safety equipment conforms with the latest International Convention, and the deck spaces are very generous. The "Isle of Sark" is designed for both day and night travel and can carry 1350 passengers with a crew of 60. She has a measurement of 2211 gross tons and her sea speed is about 19½ knots.

Proposed German Shipping Credits.

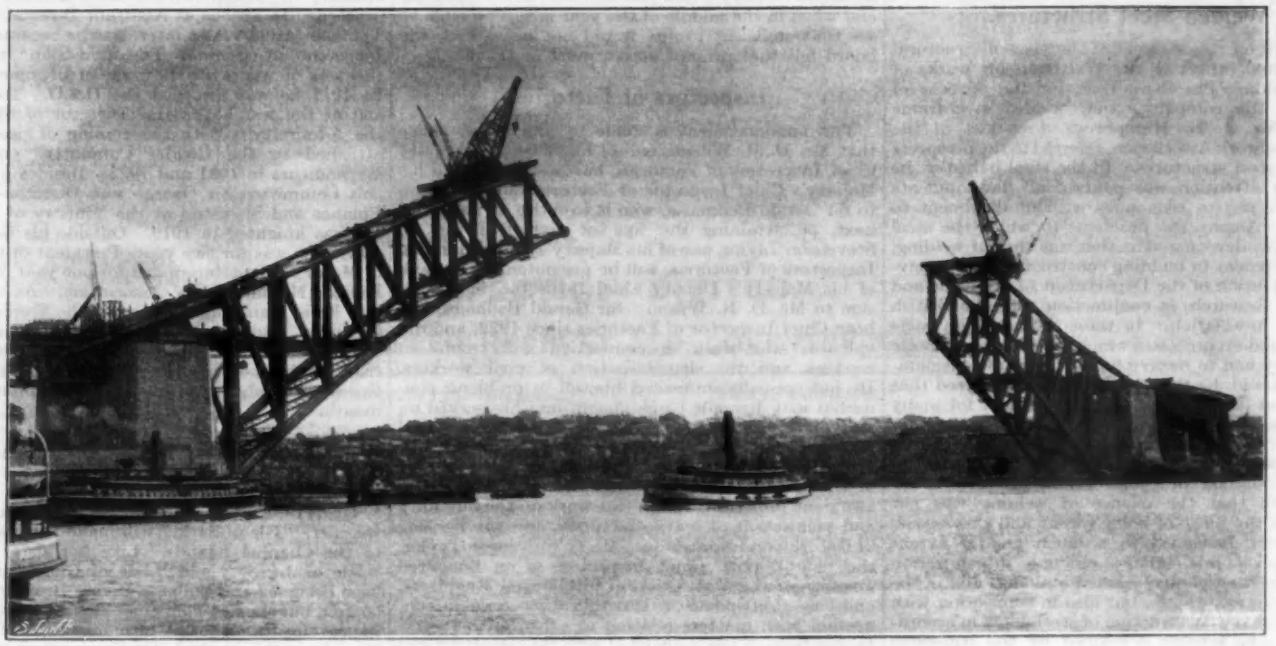
ACCORDING to the *Kölnische Zeitung*, which is usually a particularly well-informed source of information, it is expected that the German Government will shortly, by means of an emergency decree, assume the power to grant to the allied Hamburg-Amerika, North German Lloyd shipping group guarantee credits of probably 60 to 80 million marks, or about four million sterling at par. These two shipping companies together control about 75 per cent. of the total tonnage of the German mercantile fleet, which is the fourth largest in the world, and numbers in its North and South Atlantic trade some of the latest and fastest ships afloat. It is understood that the two companies will reduce their share capital in the ratio of ten to three, which, if done, would show a book profit of about 114 million marks for each company and would leave the share capital at about 49 million marks. In view of the possible reorganisation and rationalisation, it seems likely that existing Government and Dutch credits, now about due for repayment, will be renewed, and that both the German State Railways and the Postal Service will aid the shipping companies in whose business they have such a close interest.

Salving the M 2.

DURING the past week further progress has been made towards the salving of the submarine "M 2," which sank off Portland Bill. The work is being carried out by the Admiralty under the personal supervision of Mr. E. F. Cox, of Cox and Danks, Ltd., London. Last week the work of fitting and cementing the closing plates on the open aeroplane hanger was resumed and is now practically complete. It was found, however, that the cementing of the hatches, which was carried out about two weeks ago, has not been entirely successful, and when the divers again descend to the vessel some of this work will have to be done again. Meanwhile all arrangements for the pumping of compressed air into the sealed up vessel have been completed. At present the submarine depôt ship "Adamant," the diving ship "Tedworth," the mooring lighters "Moordale" and "Steady," along with the drifter "Lunar Bow," are all in Portland Harbour awaiting better weather conditions. In a week or so strong tides are expected, and all efforts will be made to raise the ship, if possible, before the tidal difficulties set in.

SYDNEY HARBOUR BRIDGE UNDER CONSTRUCTION

DORMAN, LONG AND CO., LTD., MIDDLESBROUGH, CONTRACTORS



Sydney Harbour Bridge.

No. I.

EIGHT years almost to a day since the award of the contract for its construction, Sydney Harbour Bridge is to be officially opened to traffic to-morrow, Saturday, March 19th. It crosses Sydney Harbour, New South Wales, in a single arch span of 1650ft., as measured from centre to centre of its hinges. The arch rises to a height of 440ft. From the deck suspended from the arch to the surface of the water there is a clear height of 170ft., a height sufficient, as the illustration on page 314 shows, to permit a ship as large as the P. and O. liner "Strathnaver" easily to pass beneath. On a total width of 160ft., the bridge carries four railway tracks, a roadway 57ft. wide, sufficient for six lines of vehicular traffic, and two 10ft. footways. The main span is flanked by masonry pylons of massive, but remarkably harmonious proportions, and is approached on each side of the harbour by five steel spans. The manufacture and erection of the steel work, the whole of the civil engineering work—in short, the complete construction of the bridge was carried out by Dorman, Long and Co., Ltd., of Middlesbrough, to designs prepared by Mr. Ralph Freeman, M. Inst. C.E., M. Am. Soc. C.E., the company's consulting engineer.

In this and succeeding articles we give a full account of the design and construction of the bridge. For the facilities requisite to enable us to compile our account of this noteworthy structure we are indebted to its builders, and we desire to take this early opportunity of thanking Messrs. Dorman, Long for the courtesy which they have extended to us in placing at our disposal the official documents, drawings, and photographs on which our articles are based or by which they are illustrated.

HISTORICAL AND PERSONAL.

For well over a hundred years proposals for the construction of a bridge across Sydney Harbour have been made by various parties. The first suggestion on record was advanced in the year in which Waterloo was fought, when a report on the subject was submitted to Governor Macquarie by the Government Architect. With the growth of Sydney on both sides of her magnificent waterway, an increasing amount of traffic was thrown upon the ferries, and throughout the whole of the nineteenth century the possibility of building a bridge across the harbour continued at intervals to attract public interest. In 1900 the proposals began to take definite shape, in so much that in that year the New South Wales Government invited competitive designs for a bridge. Numerous schemes were submitted, but in the end no contract was let. In 1911 and 1912, after a prolonged inquiry, the Public Works Committee recommended that a cantilever bridge should be built from Dawes Point to Milsons Point in order to provide the roadway accommodation required to link the city with its rapidly developing residential area on the opposite side of the harbour, and to carry the City and Suburban Railway. The subject continued to attract interest, and some ten years later, in 1922, the Government of New South Wales passed an Act authorising the building of a bridge across the harbour.

In January, 1923, the Government invited tenders for the construction of a bridge in accordance with a project and specification prepared by Dr. J. J. C. Bradfield, Chief Engineer of the New South Wales Public Works Department. Dr. Bradfield's specification referred particularly to cantilever and arch types of bridge. It defined the situation and the principal requirements and laid down the length of the main span and of the approaches and the navigation clearance under the deck. In addition, it prescribed the disposition and dimensions of the railway, roadway, and footway tracks, and the loads for which the bridge was to be designed. The following clause, taken from the specification, will serve to indicate the degree of responsibility which the contractors were required to undertake:—

"The contractor must satisfy himself as to the sufficiency and suitability of the design, plans and specification upon which the bridge is to be built as the contractor will be required to guarantee the satisfactory erection and completion of the bridge, and it is to be expressly understood that he undertakes the entire responsibility not only for the materials and construction of the bridge, but also for the design, calculations, specifications and plans furnished to or by him for the quantities submitted by him in his tender as accurately representing

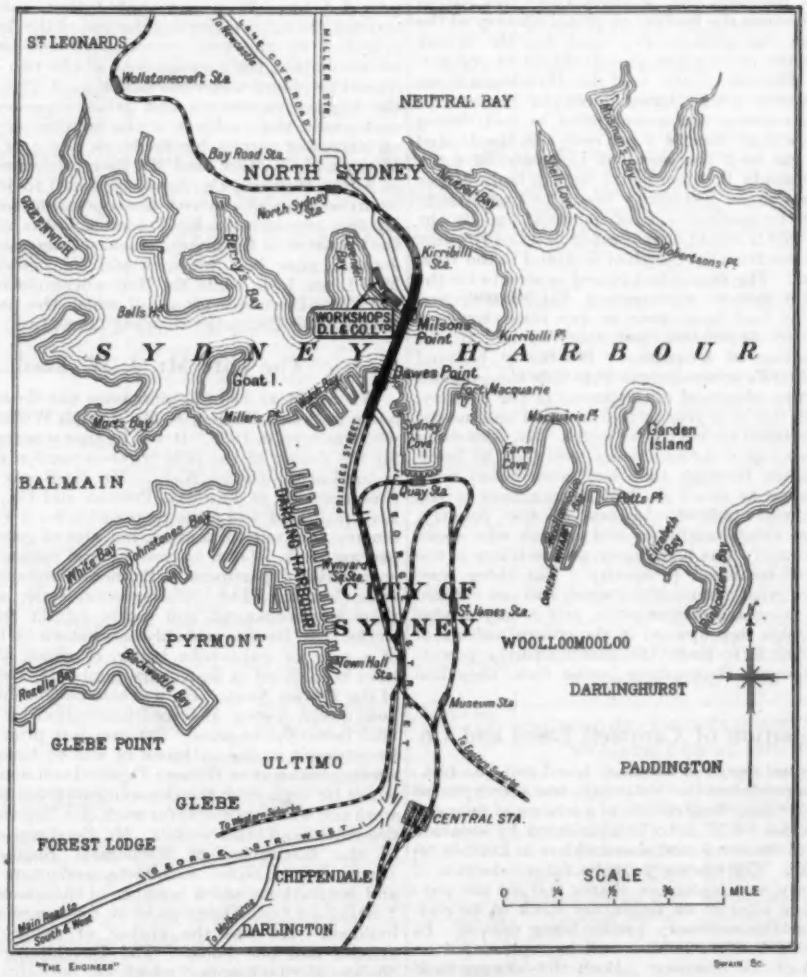


FIG. 1—SYDNEY HARBOUR AND THE SITE OF THE BRIDGE

the amount of work involved and for the sufficiency of the bridge for the loads therein specified."

Designs and tenders, covering in all twenty projects, were submitted by some of the world's leading bridge building firms, in response to the Government's invitation. The proposals submitted included every known type of large-span bridge, with various forms of architectural treatment. The contest for the contract was world-wide. In March, 1924, the contract was awarded to Dorman, Long and Co., Ltd., the accepted tender being for an arch bridge, which formed one of seven proposals submitted by the firm. The designs covered by these seven proposals were prepared by Mr. Ralph Freeman, of Sir Douglas Fox and Partners, with whom was associated, primarily in connection with the erection schemes, Mr. G. C. Imbault, formerly chief engineer of the Cleveland Bridge and Engineering Company, Ltd. The bridge was the most important which Messrs. Dorman, Long had so far undertaken. The decision to tender for its construction was taken by the late Sir Arthur Dorman and the late Sir Hugh Bell, the creators of the company's vast organisation. Not only the company and those intimately associated with it in carrying out the work, but all engineers in every part of the globe must regret that neither survived to see the completion of the great undertaking.

Three different types of bridge were covered by the tenders submitted by Messrs. Dorman, Long, namely, a two-hinged arch bridge, a two-hinged cantilever-arch bridge, and a cantilever bridge. Each type possessed certain definite advantages, but it was considered by the firm that their relative merits could be decided only by the Government's advisers. Three variations of the first design and two each of the second and third, brought the total number of proposals submitted by the firm up to seven. These variations related to different architectural treatments of the individual designs. In order that the architectural features should be worthy of the bridge and of its site, the company entrusted the designing of the masonry features of all the seven proposals to Sir John Burnet and Partners—now Sir John Burnet, Tait and Lorne.

The alternative designs submitted by the company are illustrated in Fig. 2, two architectural modifications, namely, B 1 and C 1, being omitted. The tenders were as follows :—

		£
A 1.	Arch with granite piers and no pylons	3,499,815
A 2.	Arch with white concrete piers and white concrete pylons	4,233,105
A 3.	Arch with granite piers and granite pylons	4,217,721
B 1.	Cantilever-arch, with granite piers	3,709,686
B 2.	Cantilever-arch with white concrete portals and piers	3,941,728
C 1.	Cantilever bridge with granite-faced piers	4,551,758
C 2.	Cantilever bridge with white concrete piers	4,310,812

The tender accepted was that designated A 3, but with the design of the pylons modified by Sir John Burnet and Partners to agree with the outline of the pylons of design A 2 and with the abutment arch omitted. The pylons were to be faced with granite. The number of spans in each approach was to be five. The design, as finally adopted, is shown in plan and elevation in Fig. 3.

The weight of steel involved in the contract is 51,000 tons, of which 38,000 tons is in the main arch. The specification on which the tenders were based laid it down that as far as possible the materials for the bridge should be produced and manufactured in New South Wales. To meet this requirement Messrs. Dorman, Long obtained about one-quarter of the plain steel from the Broken Hill Proprietary Company, Ltd., the reinforcing rods from Australian Iron and Steel, Ltd., and the whole of the rivets from Messrs. McPhersons, of Melbourne. With the exception of the main bearings—which were manufactured completely by the Darlington Forge Company, Ltd., of Darlington, England—and of some special forgings, the rest of the steel was produced by Messrs. Dorman, Long at Middlesbrough from their own raw materials and under their continuous direct control. The steel produced at Middlesbrough was of a special silicon character, and was required in some cases of a size and section which even Messrs. Dorman, Long had not previously produced.

To comply with the requirements of the specification and for other reasons, it was decided that the fabrication of the steel work for the bridge from the material obtained locally, or from Middlesbrough, should be undertaken in shops which were to be erected and equipped on a site adjoining that of the bridge. The labour, skilled and unskilled, for the manning of these shops and also for the actual erection of the bridge was obtained in Australia. At the busiest period the shops employed about 800 men in three shifts and registered an output of 2000 tons per month. The contractors speak in high terms of the efficiency, loyalty, and workmanship of the labour staff throughout the course of the contract.

The granite for the piers and pylons was obtained from a quarry at Moruya, on the sea coast, about 150 miles south of Sydney. This quarry was provided by the New South Wales Government, but Messrs. Dorman, Long had to equip and staff it, and to build a small township to house the quarrymen and their families. From 1925 to 1931 about 240 men were employed at the quarry. Many of them were recruited in Aberdeen.

All the calculations, designs, and working drawings were made in a special office established in London, and under the personal supervision of Mr. Ralph Freeman. The staff of this office also prepared the lists of all raw materials, rivets, bolts, and other accessories, and attended to the ordering of the material in England or Australia. The engineers in charge of the workshops and the erection of the bridge were all drawn from the company's Middles-

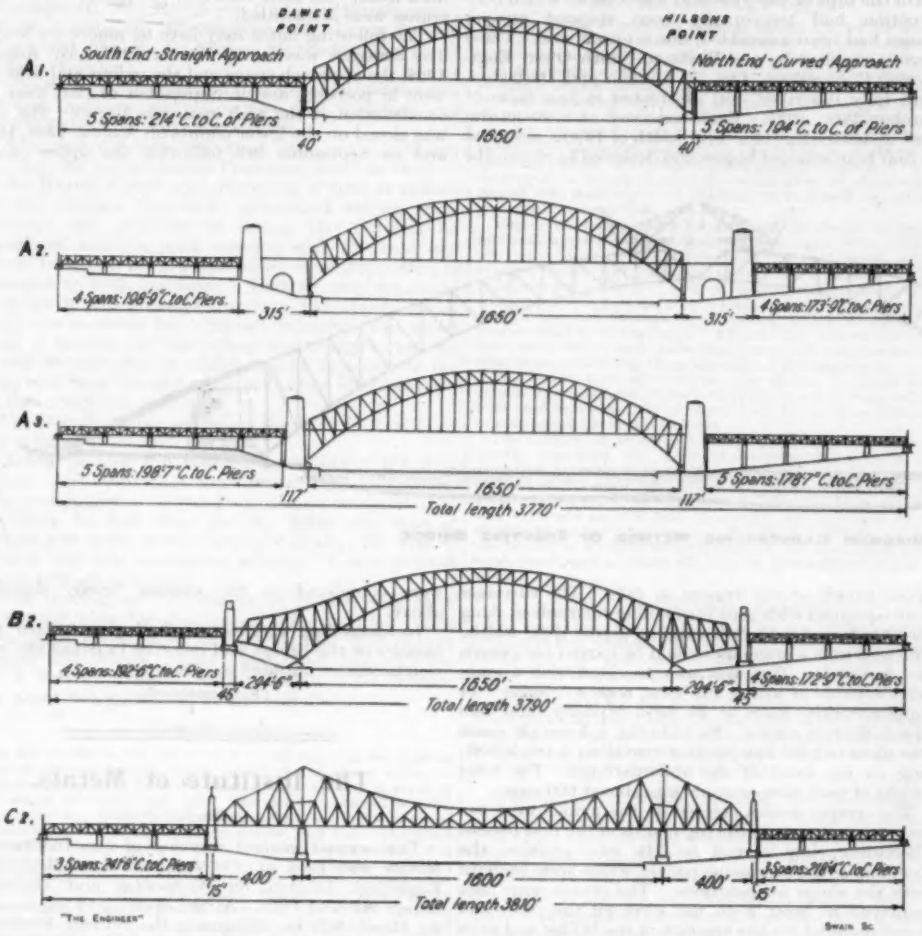


FIG. 2—ALTERNATIVE DESIGNS SUBMITTED BY MESSRS. DORMAN, LONG AND CO.

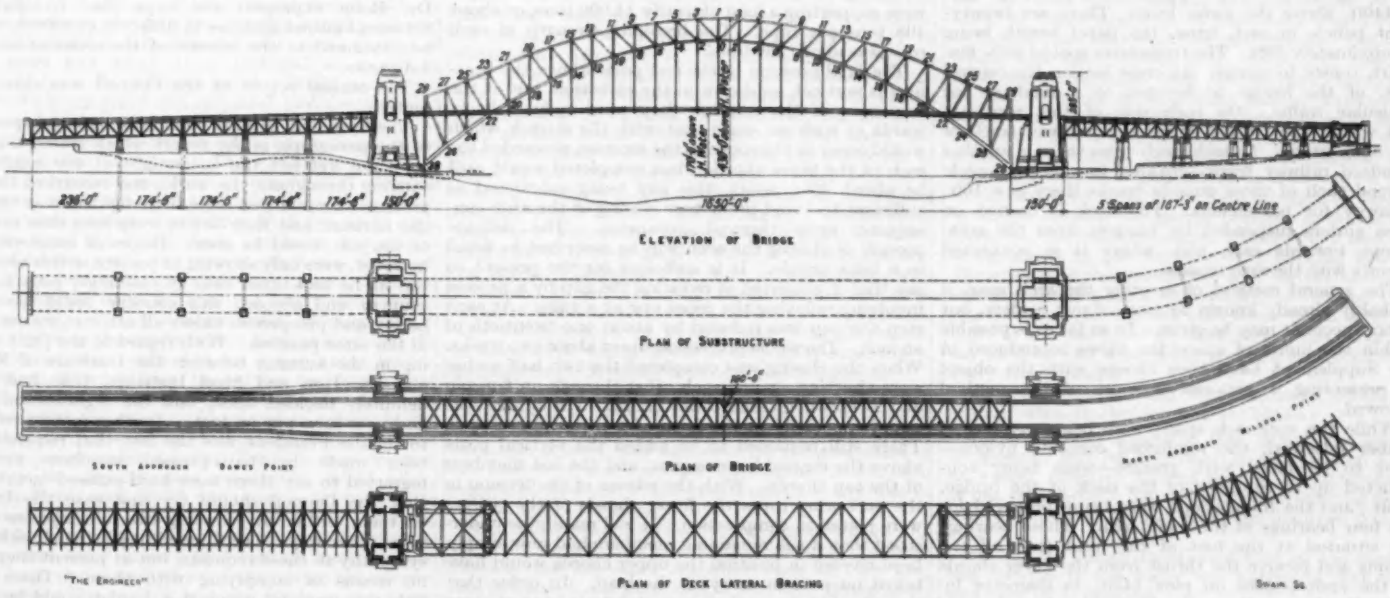


FIG. 3—ELEVATION AND PLANS OF THE ACCEPTED DESIGN

brough works. Throughout the whole period Mr. Lawrence Ennis, a director of the company, was in sole charge of the work in Sydney, with Mr. A. Martin as his chief assistant. Mr. H. Martin was the superintendent of the shops' staff, and Mr. C. Hipwell was the superintendent of the field staff for steel work erection. Mr. R. H. Blake and Mr. J. Muir served in succession as superintendent of civil engineering.

The Bridge and its Construction in Outline.

Leaving these historical and personal items, we will conclude this introductory article with a brief, general description of the bridge and the manner of its erection.

As is shown on the map, Fig. 1, the bridge spans the harbour in an approximately north and south direction from Dawes Point to Milsons Point. At this position the breadth of the harbour is considerably less than at any other alternative crossing, which would serve the business centre of the city. On both sides of the harbour excellent foundations are provided by the subsoil rock. From the water surface the ground on each side rises steeply, a feature which facilitated the construction of the approach spans. In order to provide the required navigation clearance beneath the deck of the arch span, the approach spans are graded upwards, the slope being 1 in 40 at the south end, and 1 in 39 at the north end. With this lay-out there is a clearance of 170ft. above high-water level beneath the central 600ft. of the arch span deck. As shown in Fig. 3 the south approach is straight, while the north approach is curved to a radius of 1423ft. In the south approach there are four spans of 174ft. 6in. each, and one span of 238ft. In the north approach there are five spans of 167ft. 3in. The total length of the bridge, as measured from the ends of the approach spans, is 3770ft. The pylons flanking the main arch rise to a height of 285ft. above the water level.

The arch span is carried on two hinges lying at a height of 27ft. 6in. above the mean water level, and spaced 1650ft. apart, centre to centre. The lower chord of the arch rises to a height of 350ft. above the hinges. At the crown the arch trusses have a depth of 60ft., and at the hinges a depth of about 188ft. At the centre the upper chord reaches a height of 440ft. above the water level. There are twenty-eight panels in each truss, the panel length being approximately 59ft. The trusses are spaced 98ft. 6in. apart, centre to centre. In cross section the central 57ft. of the bridge is devoted to a roadway for vehicular traffic. On each side of this roadway, and within the trusses, there is a railway track of 4ft. 8½in. gauge. Outside each truss there is another standard railway track—making four in all—while beyond each of these outside tracks there is a 10ft. pathway for pedestrians. The deck is carried on cross girders suspended by hangers from the arch, except towards each end, where it is connected directly with the arch trusses.

The general method of erecting the arch span is probably already known to most of our readers, but a short account may be given. In so far as is possible within the limits of space the views reproduced in our Supplement have been chosen with the object of presenting a pictorial account of the method followed.

While the approach spans were being erected on timber falsework the reinforced concrete pylons—later to be faced with granite—were being constructed up to the level of the deck of the bridge, 155ft., and the foundations were being prepared for the four bearings of the main span. These bearings are situated at the foot of the front faces of the pylons and receive the thrust from the lower chords of the arch trusses on pins 14½in. in diameter by 13ft. 8in. long. From the lower chords end posts extend vertically upwards in line with the bearings and are connected at their upper ends to the upper chords. The first step in the erection of the arch consisted of assembling the lower chord members of the panels adjacent to the bearings on each side of the harbour. At their inner ends these chord members were supported on the bearings and at their outer ends on steel work erected from the ground. The first panels were then completed by the erection of the end posts, the diagonals, the second posts, and the upper chord members. From the top end of one end post on each side of the harbour 128 wire ropes were led backwards into an anchorage tunnel cut in the sandstone rock. This tunnel sloped downwards at about 45 deg. and bending round in the form of a U passed beneath the line of the approach spans and rose to the surface on the other side. The wires were carried round this bend and were attached to the other end post of the first panel.

On the tops of the pylons at the level at which construction had temporarily been stopped creeper cranes had been assembled, one on each side. These cranes, supplied by the Wellman Smith Owen Engineering Corporation, Ltd., of London and Darlaston, were fully described and illustrated in our issue of October 28th, 1927. Each consisted of a structural steel undercarriage of a total width of 148ft., mounted on four four-wheeled bogies and designed to run on the upper chords of the trusses as rails. The carriages were equipped with gear for hauling themselves along the chords and with rails running across their width. On these rails a crane unit could be moved backwards and forwards. This unit was provided with a main hoist capable of lifting 120 tons, with a "jigger" or supplementary hoist of 20 tons capacity, and two 2½-ton derrick cranes. In addition, a 5-ton jib crane was mounted for independent travel on a track 50ft. long on the front of the undercarriage. The total weight of each creeper crane was almost 600 tons.

The creeper cranes erected on the pylons were run out over ramps on to the top chords of the first panels. Thereafter they served to lift into position the members of the successive panels, which were brought from the shops on pontoons. The cranes were also employed to hoist from the river all the tools and stores required for the erection of the bridge and even the officials and workmen in their daily comings and goings. The cranes in effect laid their own tracks in mid air and having laid a section moved out on to it ready to lay the next. By the time the two half spans met over the harbour each crane had travelled over 800ft. outwards from its starting point and was standing well over 400ft. above the water surface. Its weight and the weight of all the material it had laid, amounting to a considerable proportion of the 19,000 tons in each completed half arch, were supported entirely by the 128 wire ropes forming the anchorage. Just before the arch was closed the ropes were supporting a load of nearly 14,000 tons, or about 108 tons per rope. The breaking strength of each rope was about 360 tons.

The final position of the end posts above the bearings is vertical, as shown in the elevation, but at the beginning of the erection they were inclined backwards at such an angle that with the stretch which would occur in the ropes as the erection proceeded the ends of the lower chords when completed would still be about 40in. apart, this gap being calculated as sufficient to avoid premature closing of the arch consequent upon thermal expansion. The delicate process of closing the arch will be described in detail in a later article. It is sufficient for the present to say that it consisted of reducing the gap by a process involving relieving the ropes one at a time. At each step the gap was reduced by about one-twentieth of an inch. The whole process occupied about two weeks. When the closing was completed the two half arches were abutting against each other through an 8in. pin at the crown of each lower chord. The bridge was now temporarily in the form of a three-hinged arch. There still remained to be added the vertical posts above the central bearing pins, and the last members of the top chords. With the release of the tension in the anchoring ropes the lower chords of the trusses were placed in compression. It will readily be understood that if the remaining members had now simply been riveted in position the upper chords would have taken no part in carrying the load. In order that they should take up their correct duty it was necessary to couple up the upper chords of the two half arches while the chords were under a calculated amount of compression. This object was achieved by dividing the vertical posts above the central pin into two similar parts, each of which supported the corresponding portion of the upper chord. When each half arch had been completed by the addition of these members the ends of the top chords were separated by a gap of about 2ft. 6in. In this gap hydraulic jacks were inserted. When the calculated stress had been thrown upon the upper chords by the operation of these jacks the gap was closed by fitting into it carefully machined steel slabs. The bridge was thereby converted into a two-hinged arch.

Following the completion of the arch trusses the creeper cranes reversed the direction of their travel. As they passed backwards to the pylons they lifted from the river the hangers for the suspension of the deck and the cross girders and other members of the deck itself. On their return to the pylons the creeper cranes were dismantled.

The following dates may here be placed on record. The contract was let in March, 1924. By August, 1928, the approach spans and the pylons and bearings were in position, and in September of that year the construction of the arch span was begun. The arch was closed on the lower chords on August 19th, 1930, and on September 9th following the upper chords were completed in the manner briefly described above.

In succeeding articles we shall give further particulars of the bridge and describe in detail the erection processes outlined in this article.

(To be continued.)

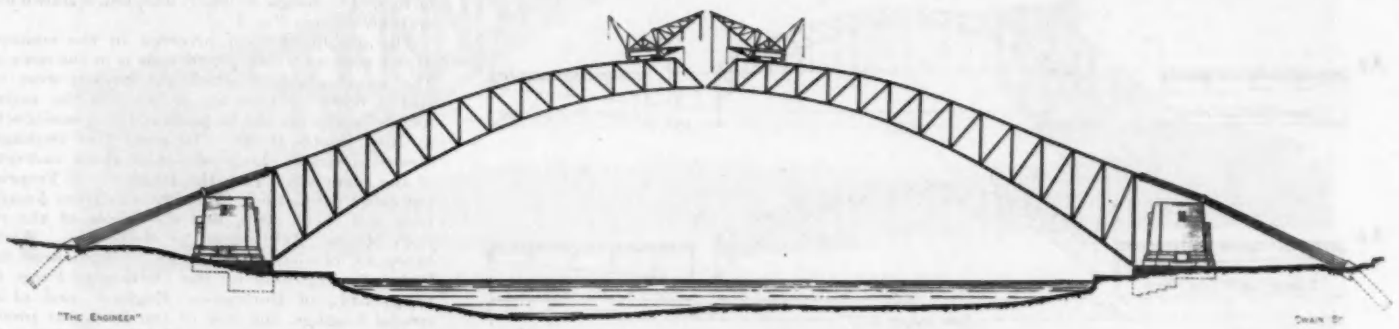


FIG. 4—DIAGRAM ILLUSTRATING METHOD OF ERECTING BRIDGE

The Institute of Metals.

No. I.

The annual general meeting of the Institute of Metals was held at the Institution of Mechanical Engineers, London, on Wednesday and Thursday, March 9th and 10th. At the opening of the meeting on March 9th Dr. Seligman, the retiring President, was in the chair, and offered a cordial welcome to the foreign members who had come over for the meeting, specially mentioning Dr. W. Rohn, of the Deutscher Gesellschaft Metallkunde; Professor George Sachs, also of Germany; and Colonel Belaiew, the latter of whom is now living abroad after a long period of residence in England.

Dr. Rohn, in a short speech, expressed his appreciation of the welcome offered to the foreign members, and regretted that owing to the general situation not so many had been able to attend this year. In offering the greetings of the German society, Dr. Rohn expressed the hope that co-operation between kindred societies in different countries would be continued to the benefit of the societies and the industries.

The annual report of the Council was then presented.

The President, in a few comments, referred specially to the paragraph in the report which stated that we have not yet felt the full weight of the conditions existing throughout the world, and remarked that at present we could just see a little light almost beyond the horizon, and that before very long even the rim of the sun would be seen. Hopes of improvement, however, were only showing at present in this country, but as he had often said at meetings, both in this country and abroad, this country could never be happy and prosperous unless all other countries were in the same position. With regard to the joint meeting in the autumn between the Institute of Metals and the Iron and Steel Institute, that had been definitely decided upon, and the organisation of it had now been put on foot. Another matter referred to by the President was the fact that requests had been made by hard-pressed members—and he regretted to say there were hard-pressed members—that the Council should try and ease the burden on them, either by reducing the subscriptions or in some other way. The Council had listened with keen sympathy to these requests, but at present there was no means of complying with them. There were only two ways by which this burden could be eased because the Institute had nothing to spare—indeed, rather the contrary. One way was to reduce the services to the members—which would be a very retrograde step—and the other way was to try by all means to secure such collaboration between the Institute and other kindred societies as would prevent some of the immense amount of overlapping which goes on, and to see if in that way it was possible constructively to reduce the burden on the members. The attention of the Council had been definitely

drawn to that, and although it would be a long road, he hoped ultimately it would be possible to reach that goal.

The election of officers and new members of Council was announced as follows :—

President : Sir Henry Fowler (Derby).

Vice-presidents : Mr. W. R. Barclay (London), Dr. H. Moore (Woolwich).

Members of Council : Mr. Maurice S. Gibb (West Hartlepool), Mr. R. Lloyd Gibbins (Birmingham), Mr. E. L. Morcom (Birmingham), Mr. James Stevens (Glasgow), Mr. W. G. Turner (Sheffield), Mr. H. B. Weeks (London).

The Secretary announced that since the last meeting of the Institute sixty-nine new full members and student members had been elected.

The retiring President then inducted Sir Henry Fowler, the newly elected President, into the chair.

Sir Harold Carpenter, proposing a vote of thanks to the retiring President, mentioned among other matters the question of easing the burdens on members, and the joint meeting with the Iron and Steel Institute, adding that there were 300 members common to both institutes. That, he said, suggested whether it was necessary to have two organisations with two entrance fees and two subscriptions, which were a burden on the young metallurgist, and he would do anything he could, as hon. treasurer of the Iron and Steel Institute, to facilitate a simplification of that condition of things.

Dr. Harold Moore seconded the vote of thanks to the retiring President.

Before putting the vote to the meeting, the President announced that the Council had elected Dr. Seligman a Fellow of the Institute, in recognition of the work he had done for it. After the vote of thanks had been carried enthusiastically, Sir Henry Fowler read his presidential address. It was printed in our issue of last week.

The reading and discussion of papers was then proceeded with, the first paper being entitled "The Relative Corrodibilities of Ferrous and Non-ferrous Metals and Alloys : Part III., Final Report," by Dr. J. Newton Friend. In the absence of Dr. Friend, the paper was presented by the secretary.

CORRODIBILITY.

It is reported in this paper that nearly one hundred bars of ferrous and non-ferrous metals were exposed to sea action in Southampton Docks for three years, and an account is given of the results of seventy-two cases. The metals examined included lead, zinc, tin, aluminium, copper, nickel, and various alloys containing iron, chromium, nickel, copper, and zinc. The effect of grain size on the corrodibility of brass has been studied. The results appear to indicate that small grain is preferable to coarse. Nickel-copper alloys, particularly the 70 : 25 alloy, offered great resistance to corrosion. High-grade zinc and tin were slightly more attacked than the less pure metals. The effect of arsenic in copper is discussed. Tension, riveting, and cold working did not appreciably affect the corrosion of nickel-chromium alloy steels, but in every case cracks appeared at welds. Shell faunæ did not appear to affect the corrosion of the metals appreciably while living. Dead shelly faunæ stimulated localised corrosion in alloy steels, nickel, and nickel alloys not rich in copper. The alloy steels resisted corrosion well, but previous results showing that alloy steels are subject to serious localised corrosion are confirmed.

Professor Thomas Turner, speaking in the discussion, said the work done by Brühl and referred to in the paper was done in his laboratory over twenty years ago, and Brühl's paper was the first contribution on the subject of corrosion communicated to the Institute, but it had been developed considerably in other hands in the interval. Brühl in his paper did not make such a definite statement on the matter of the large and small grain material as might be inferred from Dr. Friend's paper. Brühl took a roll of 70/30 brass plate and annealed two specimens at the same temperature, but for different times. One of those specimens developed a much larger grain structure than the other. The specimens were then placed in synthetic sea water and the rate of corrosion observed for fifteen weeks. On immersion the small-grain specimen lost approximately 5 per cent. more weight than the coarse-grain specimen, but at the end of twelve weeks the reverse effect was observed. The work had to be cut short at the end of fifteen weeks, but the trials showed that after twelve weeks the rate of corrosion was gradually altering, and in all probability the curves would have crossed had the experiment been conducted for a few weeks longer. Therefore it would not be correct to suggest that Brühl concluded that small-crystalline structure was conducive to the most rapid corrosion, except in the initial stage. Moreover, Brühl's experiments were scarcely comparable to Dr. Friend's experiments, because Dr. Friend used practically 60/40 alloy, whereas Brühl used 70/30, and these would have quite different rates of corrosion in sea water. Hence, we still required further information as to why in some cases small grain might corrode more quickly than large grain, and why in other cases the reverse happened. The remark was also made in the paper that the less pure the metal, the better it would resist corrosion. That raised a very wide field of inquiry. If impurities were responsible for the good effect, how much of a particular impurity would be beneficial ?

The President, proposing a vote of thanks to Dr. Friend, said, although that report was the "Final" one, it by no means represented the end of the matter. He himself was doing some work in the same connection from a rather different standpoint, and what he wanted to know but had not yet found out was what the shelly substances referred to in the paper left behind, and were they alive or dead ?

The two papers of which we give summaries below were then presented and discussed together. They were entitled :—"The Properties of Copper in relation to Low Stresses," by O. F. Hudson and J. McKeown, and "The Properties of Copper in relation to Low Stresses," by H. J. Tapsell and A. E. Johnson.

THE PROPERTIES OF COPPER.

Some results of previous research carried out by the British Non-Ferrous Metals Research Association on the subject of locomotive fire-box stays and plates—*J.*, Inst. Metals, 1929, 42—had demonstrated the marked improvement in the elastic properties of copper containing small amounts of added elements, by work hardening followed by low-temperature heat treatment. That work also demonstrated the beneficial addition of small amounts of some foreign elements, such as silver, tin, &c., in raising the temperature limit at which loss of elasticity and softening occurs. The present paper gives the results of further investigation, having in mind the potential wider application of copper with such improved elastic properties and resistance to permanent deformation.

Five types of copper have been studied, namely, H.-C. copper ; arsenical copper with and without the addition of silver, 0·05–0·1 per cent.; copper containing about 0·1 per cent. silver, without arsenic ; and copper containing about 1 per cent. tin and about 0·02 per cent. silicon. Rods of these materials with known amounts of cold work have been subjected to heat treatment for various times at different temperatures, and tensile and compression tests have been made. Tensile tests were carried out at room temperature and at 300 deg. Cent., and compression tests were made at 300 deg. Cent. and also at 350 deg. Cent.

The tensile tests have shown that all the materials tested possess a certain limit of proportionality due to the applied cold work, and that this limit of proportionality can be considerably raised by suitable heat treatment.

The amount of permanent deformation due to stresses not greatly exceeding the limit of proportionality have been measured in tension at ordinary temperatures and in compression at 300 deg. Cent. and 350 deg. Cent. The results have shown the superior resistance to deformation brought about by cold work and suitable heat treatment, and have also demonstrated the greater resistance to deformation conferred on copper, particularly at elevated temperatures, by the presence of a very small percentage of silver and also by the presence of tin and silicon.

THE PROPERTIES OF COPPER.

The paper deals with the results of creep tests on two copper alloys, the first containing 0·34 per cent. arsenic only, and the second 0·31 per cent. arsenic together with 0·072 per cent. silver. Both alloys were tested in the soft condition, and also in the condition arising from 5 per cent. cold work followed by heat treatment at 300 deg. Cent. and 350 deg. Cent. respectively. It is shown that improvement in resistance to creep at 300 deg. Cent. and 350 deg. Cent. is effected by the special pre-treatment of the alloys, and that the alloys containing 0·072 per cent. silver are superior to the silver-free alloys.

Professor D. Hanson, opening the discussion on these two reports, said he hoped it would be realised from them that we were witnessing the birth of a new type of heat treatment in non-ferrous metals, which promised to be very important. There had been described a process for raising the elastic limit or limit of proportionality of non-ferrous alloys without greatly affecting the ultimate strength or elongation, and in the process that had been described was to be seen a method of converting many of the non-ferrous alloys formerly used into materials of much greater engineering utility. A small point arising out of the paper by Messrs. Tapsell and Johnson was the influence of silver. Had the authors analysed their samples for other impurities ? There might be iron, nickel, and other things which would vary in different samples of alloy which might in part account for the differences which the authors had attributed solely to silver.

Dr. Walter Rosenhain first referred to the use of the word "stiffness" in the paper by Dr. Hudson, as indicating the resistance of a metal or alloy to slow plastic deformation. It was desirable, however, that a different term should be used, because "stiffness" in reality should be measured by the elastic modulus and by nothing else, and that did not come into account in the present case. If that work was carried further, the authors should pay attention to some of the other alloys of copper which had been studied recently ; for instance, alloys containing antimony and arsenic and antimony, because they had very interesting mechanical properties, which might prove to be as good as those of coppers containing silver. Moreover, he was in agreement with Professor Hanson in suggesting that silver, even when in small amounts was not the only variable. The concentration of oxygen and other impurities in those alloys was a matter of very great importance, and should be carefully studied in each material.

The President said he had been hoping that something would be done on the other side of the Atlantic on the question of the effect of silver, because in conversation a short time ago with Dr. Burgess, head of the Bureau of Standards at Washington, it had been suggested that one of the problems of the day was to find an outlet for silver.

Mr. McKeown, replying to the discussion on the paper by himself and Dr. Hudson, assured Professor Hanson that the other impurities were all very low, and in Table I. the same copper was used throughout, except that in certain cases there was the addition of the small amount of silver. As to the use of the word "stiffness," he expressed the hope that Dr. Rosenhain would be able to suggest a better word.

Dr. Rosenhain : "Plasticity" is the obvious word.

ALUMINIUM AND WATER.

The first paper taken on Wednesday afternoon, March 9th, was the "Note on the Interaction of Aluminium and Water Vapour," by Dr. R. Seligman and Mr. Percy Williams. It gives an account of experiments made to test the truth of a statement that aluminium and its alloys are rapidly attacked by superheated steam at 300 deg. Cent. It was found that no such attack takes place.

In the course of some additional comments when introducing the paper, Dr. Seligman said that since the paper was originally completed the experiments had been extended to temperatures of 200 deg. and 500 deg. Cent., and whereas no such action as that described by Guillet and Ballay in their earlier experiments had been found, it was not absolutely certain that something did not go on at the higher temperatures, and at still higher temperatures than he had just mentioned. He had recently been working at 620 deg. Cent., which was about as high as it was possible to go in that matter, and, having regard to the appearance of blisters on the samples, it was not absolutely certain that some change was not taking place.

Professor D. Hanson said it must be satisfactory to those engaged in the aluminium industry to know that the results described by Guillet and Ballay were not characteristic of all aluminium when exposed to steam at high temperatures. He himself had studied the action of water on aluminium for different purposes, and had found most definite evidence of reactions between aluminium and many of its alloys at ordinary temperatures when there was contact with liquid water and at much higher temperatures than those which had been mentioned by Dr. Seligman, viz., when the metal was molten. In that state aluminium would decompose water very readily, generating hydrogen and aluminium oxide. It was, however, very interesting to have the evidence in that paper that there was an intermediate region in which the reaction did not appear to be rapid. Considering the chemical nature of aluminium, one would expect it to react with water at all temperatures, whether the water was liquid or vapour, and he suggested to the authors that the cause of the failure, in their case, to develop any appreciable action under the conditions of their experiments must be due to something which prevented the water from coming into proper contact with the aluminium. It rather seemed that the protective film, although very thin, was sufficiently continuous and impervious to aqueous vapour, within the region of those experiments, to act as a real protection.

Mr. T. H. Turner suggested, as the result of experiments with aluminium in relation to reciprocating engines and turbines, that in commercial practice there was always a trace of oil present which prevented the actual contact of superheated steam with the aluminium. In that case the effect was not so pronounced as in the case of the authors' carefully conducted experiments, and, as a matter of fact, the aluminium was shown to stand up to superheated steam under practical conditions for a considerable time.

Dr. A. G. C. Gwyer (British Aluminium Company) suggested that the immunity that had been found at 600 deg. Cent. must be due to the fact that the steam was dry. Hanson had shown that at 700 deg. Cent. there was an action, and it would be interesting to know at what temperature action definitely started.

Dr. W. Rosenhain suggested that the immunity in the case of the authors' experiments was due not only to the fact that the steam was dry, but also to the fact that there was no abrasive action of any kind, as there might be in industrial steam owing to the existence of particles of solid matter. Specimens which had come before him, which had blistered even more markedly than the authors' specimens, showed evidence of something having entered the metal from outside, and if that happened in an atmosphere of pure, dry steam, the only thing which could enter was hydrogen produced by the reaction with the water vapour. Speculating on that matter from work done upon steel, he thought it might be that the hydrogen entered the metal, possibly in the atomic form, in the nascent state, combining inside and being unable to get out except by blowing bubbles. The answer to the question of why the metal reacted slowly at 620 deg. Cent. and quickly at 700 deg. Cent. was obvious. In the one case there was a solid and more or less fixed surface film, and in the other case the surface film was being continuously broken by every fresh bubble.

Dr. Hanson remarked that the same effect was noticed when the bubble was not blown.

Dr. Rosenhain suggested that it did not happen so quickly, and he believed the surface film acted as a very effective barrier against the interchange of gas between the metal and the surrounding atmosphere, an important fact from the practical point of view.

Mr. T. H. Turner mentioned that in the case he had referred to the water was untreated and there was very little priming.

Mr. I. D. Taverner (British Aluminium Company) said that whilst the paper was of great interest in connection with the use of aluminium alloys for high-pressure steam engines, it was to be hoped that the investigation would be carried on with the alloys commonly used for internal combustion engines. Experience in the past had demonstrated the fact that particles of water were carried over with superheated steam in the case of turbines ; but he was unable to express a definite opinion as to whether that was so also with reciprocating engines. There

was no doubt, however, that the particles of water in the superheated steam would have a severe abrasive action if the velocity of the steam was sufficient.

The President recalled that some years ago a commercially pure aluminium piston was put into a locomotive in which, undoubtedly, the steam was not superheated; but there was a sufficient quantity of water carried over to wash away the film of oil. The result was that when the cylinder cover was removed to ascertain the cause of some trouble, it was found that the piston had disappeared! Similar experiments more recently carried out with a certain alloy on shunting engines, where, again, there was no superheated steam, showed that after a few months the pistons were all right.

Dr. Seligman, in his reply to the discussion, said there must not be read into his experiments any attempt to pass judgment on the possibility of applying aluminium to steam engine practice. The conditions were totally different in that case from those under which his experiments had been carried out. Again, it should be borne in mind that Guillet and Ballay had carried out their experiments for a much longer period. Moreover, those experimenters were working on an industrial installation and definitely stated that speed did not enter into their problem, except in a matter of degree. They worked at high speed, but in what they called a stationary water vapour, *i.e.*, in the separator of the boiler where they said there was no attrition. Personally, however, he was convinced that very violent attrition occurred, and in that case again there was no comparison between their experiments and those described in the present paper. As to the point concerning blisters mentioned by Dr. Rosenhain, there was the difficulty that a similar sample was left in an ordinary furnace atmosphere for a very long time without showing any blisters. Then the specimen was cleaned and placed in a steam atmosphere, and the blisters appeared. Whether that was accidental or not he could not say, but it rather shook one's confidence in saying that the steam had no effect. How steam could pass in and then blow the aluminium out he could not say. It rather looked as if some compound was formed at the higher temperature, giving rise to molecular hydrogen and the consequent formation of a bubble.

Temperature and Elasticity of Light Alloys.

The next paper, "On the Influence of Temperature on the Elastic Behaviour of Various Wrought Light Metal Alloys," by Dr. Franz Bollenrath, was presented by the secretary in the absence of the author. In this paper details are given of the experimental determination of the modulus of elasticity and elastic limit of various wrought aluminium and magnesium alloys at temperatures between −190 deg. and +180 deg. Cent. The elastic properties were found to increase with decreasing temperature except in the cases of two aluminium alloys with a high silicon content.

Dr. J. McKeown said he was engaged at the present time on some work of that nature at moderately low temperatures, but nothing like so low as those used by the author. The accurate determination of the modulus of elasticity was at all times a very difficult matter, be it at high or low temperatures, because of the difficulty of maintaining a constant temperature during the time of the test. With materials like those of the author, having comparatively low limits of proportionality, it frequently happened that they also had a very high coefficient of expansion, hence any slight change of temperature increased the difficulties of testing, and particularly affected the slope of the elastic line. Was the author's control of the temperature at, say, −110 deg., so close as to make it certain there was no such effect? Also, were the points on the curves verified by duplicate or triplicate tests, or were they the result of one test only?

Professor C. H. Desch referred to the stress at which the first non-elastic deformation takes place—mentioned in the paper—and said that as in tests of the kind described it was not being measured, would it not be better to abandon the term "elastic limit" altogether and use the term "proof stress"? The term "elastic limit" caused a good deal of confusion when discussing the theory of deformation.

Dr. A. C. G. Gwyer suggested that in all work of that kind the details of the hot and cold work to which the bars had been subjected should be placed on record. It was not certain what was done in the case of the author's experiments. How did he fasten the constantan couples to the wires to avoid local over-heating? It was merely mentioned that they were soldered. He was doubtful about the question of creep in relation to the tests at the higher temperatures, and he did not feel that sufficient allowance had been made for that, yet it was a point of great importance. Further, although the author stated that his highest temperature was 180 deg. it must not be assumed that that was the highest temperature at which aluminium alloys could safely be used. The working temperature of a connecting rod was from 250 deg. to 300 deg., and aluminium stood up quite satisfactorily to that temperature.

Thermal Conductivity of Alloys.

A paper by Professor D. Hanson and Mr. C. E. Rodgers on "The Thermal Conductivity of Some Non-ferrous Alloys" was then introduced by Professor Hanson. In it the results of thermal conductivity tests on a series of aluminium-copper alloys, and also the effects of aluminium, nickel, iron, phsophorus and arsenic on the thermal conductivity of copper are described.

Dr. Walter Rosenhain opened the discussion by asking whether it was necessary to go on with that class of work, since, if the electrical conductivity of an alloy was known, it was easily possible to ascertain the thermal conductivity sufficiently closely for practical purposes? From the practical point of view, there was a tendency to attach unusual importance to thermal conductivity, particularly where heat transfer was concerned, but even in such cases the thermal conductivity was not nearly so important as was sometimes imagined. The properties of reflected heat might be even more important than thermal conductivity. Because there was a considerable difference in the thermal conductivity of two materials, one must not jump to conclusions as to their actual effect on the efficiency of the heating device in which they were placed.

Dr. R. Seligman, speaking on the question of heat exchange, said that the lower thermal conductivity of an otherwise suitable alloy might be the determining reason in commercial work for rejecting it. Therefore, the thermal conductivity was of considerable importance.

Dr. A. L. Norbury expressed the view that there was a need to determine the electrical and thermal conductivities of materials because the difference so obtained would enable the relationship between the two properties to be obtained and make it possible to calculate the thermal conductivity of many of the copper-rich alloys.

Dr. Hanson, replying to the discussion, agreed as to the possibility of calculating the thermal conductivity from the electrical conductivity, but the point of his experiments was to demonstrate the profound effect which small amounts of added elements could have on the thermal conductivity of an otherwise pure metal.

The final paper on Wednesday, March 9th, dealt with "Intercrystalline Corrosion of Duralumin," the authors being Messrs. A. J. Sidery, K. G. Lewis, and H. Sutton. The official abstract is printed below.

Intercrystalline Corrosion of Duralumin.

Experiments were carried out to determine the influence of overstrain in tension or in compression, and of certain modifications of heat-treatment on the tendency of duralumin to develop intercrystalline corrosion. For the purpose of evolving a reliable test which would permit the relative susceptibility of various samples of duralumin to this form of corrosion to be estimated in a reasonable space of time, several reagents were investigated. It was found that partial immersion in a N-1 solution of sodium chloride to which 1 per cent. (by weight) of hydrogen chloride had been added was capable of producing intercrystalline corrosion consistently in samples of duralumin where a propensity towards this type of corrosion existed. The effect of overstrain was examined by subjecting to this test a number of specimens of heat-treated duralumin sheet to which tensile test had been applied to produce various degrees of permanent elongation and a number of longitudinal strips cut from samples of heat-treated duralumin tube which had been compressed to arbitrarily selected stresses above the elastic limit in compression. The results of the experiments indicated that overstrain in tension increased slightly the tendency towards intercrystalline penetration; but no relation was observed between this tendency and the degree of elongation. There appeared, however, to be a critical range of stress in compression, viz., 14–16·9 tons per square inch, for the material employed in the experiments. Samples which had been compressed in this range of stress showed the greatest susceptibility. Corrosion tests were made on samples of the sheet and tube which had been heated at various temperatures in the range 470 deg. to 520 deg. Cent., quenched in cold or in boiling water and aged at room temperature with a view to ascertain the influence of such modification of heat-treatment and of quenching medium on the susceptibility of the material to intercrystalline attack. It was observed that, in general, the higher the quenching temperature the smaller was the tendency of the material to develop intercrystalline corrosion, but there was, however, an increased tendency towards the pitting form of superficial corrosion under the conditions of test employed. Material quenched in boiling water showed a very much greater propensity towards the intercrystalline form of corrosion than did material quenched in cold water or in cold oil.

Dr. Walter Rosenhain said it had been his experience in examining a good deal of duralumin which had undergone intercrystalline corrosion that, apparently, the structural elements which were formed by stamping, immediately after quenching and before or during the ageing process, had suffered much more severely than other parts which had been hot or cold rolled and afterwards heat-treated and aged. Although the experiments were interesting, he did not think the conclusions drawn by the authors were quite conclusive, because, in his view, the cause of overstrain, particularly if carried out before ageing had been completed, did not lie in the fact that the material might have been subjected to plastic deformation, but in the fact that there had been left in it serious residual stresses which rendered it self-stressed, and if the ageing took place after that, it might actually occur unevenly. Even if that did not happen the effect would be to intensify the self-stressed condition. He had always imagined, in the cases he had seen, that it was that self-stressed condition that had really caused the acceleraton of the intercrystalline corrosion. It was true that certain American experiments appeared to suggest the reverse, but the actual parts he had investigated were from airships and the channel parts were practically uncorroded, whereas the thin bracing material was heavily attacked by intercrystalline corrosion. The Americans had found exactly the converse on their airships, and that difference must be due to some very wide diversity in the manipulation of the material, with the result that the channels were more severely self-stressed than the bracing stampings. In some experiments which Archbutt and he carried out a few years ago, a zinc-aluminium alloy strip, when sprung, consistently produced intercrystalline corrosion, but if the specimen was left unstrained, the attack did not take place nearly so rapidly, although it occurred in time. Season cracking in brass was another instance in which intercrystalline attack was very much affected by stress. Therefore, he would like to know how far in these experiments the effect of overstrain played a part. He was particularly interested to note that a reagent had been found which rapidly produced intercrystalline attack, and he would like the authors to say whether they were satisfied that the material which underwent that relatively rapid attack under that somewhat fiercely corrosive reagent was also the material which underwent attack most rapidly under ordinary conditions. It was a difficult question to answer, but it was important that conclusions should not be based on an accelerated corrosion test of that kind which, no doubt, had inherent in it all the difficulties which unfortunately attached to all accelerated tests for corrosion.

Professor C. H. Desch asked whether details of the structure had been examined during the process of corrosion, because the location of corrosion at the grain boundaries might be to some extent a secondary effect due to the setting up of local couples between the substances out of solution immediately at the grain boundaries, and the surrounding metal. In 1920 he read a paper before the Faraday Society in which he showed a photograph of duralumin taken in that way in the course of a study of the metal under the microscope, and it was seen that the corrosion began not exactly at the grain boundary, but in a line parallel to the inclusions, obviously owing to the formation of local couples. That would account for the setting up of the corrosion.

Dr. Harold Moore said that although Dr. Rosenhain had suggested that internal stress might be an important factor, he personally felt that the evidence was against the suggestion that stress, as apart from strain, was very important in that matter.

Mr. Sutton, in the course of his reply, said he was unable to say how important overstrain was relatively to the stresses in the material, and he would like to go further with the work from that point of view. Fully softened duralumin appeared to be rather highly susceptible to the intercrystalline form of corrosion, although one would assume on scientific grounds that the residual stress in that material would be small. Close attention had been paid to the question of heating and the commencement of precipitation. It appeared possible, and even probable, that one stage of the precipitation process—or the various phenomena which led up to it—was of very great importance. The method of quenching and the temperature of the quenching medium appeared to be of considerable importance; but, at present, it seemed very difficult to pin down any particular aspect of the modern theory of age-hardening as being the critical point.

The meeting then adjourned until Thursday, March 10th.

During the afternoon a speech controller was put into operation on the President's table. It took the form of a box containing the now familiar red, orange and green lights of the automatic traffic controls, the speaker starting off on green, being given a warning with the orange light and, finally, being closed down by means of the red light. However, on the first day, there did not seem to be any great propensity for over-long speeches, and the President had to be content with experimenting on the unfortunate secretary when he presented papers in the absence of authors, causing him to gallop along to keep ahead of the red light, which he was threatened with at the end of a few minutes. On the second day of the meeting, however, the device was brought into more effective use, and one speaker was so scared at the red signal appearing that he broke off in the middle of a sentence and hastened from the platform almost at the run.

Annual Dinner.

The annual dinner of the Institution was held on Wednesday, March 9th, at the Trocadero Restaurant, London. A company of about 240 ladies and gentlemen assembled under the chairmanship of the President, Sir Henry Fowler. The toast list and the speeches were commendably short. "The Institute of Metals" was proposed by Mr. P. J. Pybus, the Mininster of Transport, and was replied to by the President. The only other toast was "The Guests," which was proposed by Dr. W. Rosenhain and to which Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, responded. Following the dinner and speeches there was a dance.

(*To be continued.*)

Workmen employed at the ironstone quarries at Colsterworth, near Grantham, have exposed a small box-like structure which has proved to be a Roman blast-furnace for smelting ironstone.

British Industries Fair, Birmingham

No. V. (*Conclusion*).

IN concluding our account of the exhibits at the Birmingham section of the Fair, it is interesting to note that we have just heard from a semi-official source that, taking the Fair as a whole, the business done exceeded that of last year by some 400 per cent., and that already preparations are being made for an even greater show next year. The approval with which the exhibitors regarded the Fair may be gauged from the fact that we heard more than one say that they had done enough business during the first two days to cover the cost of their displays. We have little but praise for the Fair arrangements, but think that a little more circumspection might be displayed in the admission of juniors and others, who, obviously, have no technical interest in the exhibits.

SIMPLIFIX PATENTS, LTD.

An ingenious form of pipe union, which is illustrated in Fig. 40, was exhibited by Simplifix Patents, Ltd., of 60, Victoria-road, Surbiton, Surrey. Its construction is so obvious in the engraving that it needs scarcely any description. There is a central screwed socket and two cap nuts. Inside these nuts there is a recess into which there is slipped a loose-fitting metal sleeve, as shown on the left-hand side of the sketch. The nut is then screwed up and the sleeve is deformed, as shown on the right. It then forms a tight joint between the socket and the pipe.

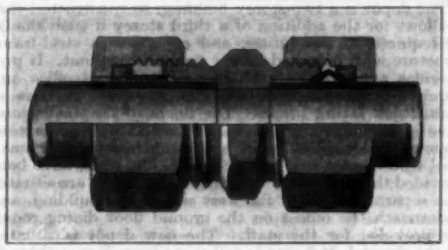


FIG. 40—PIPE UNION—SIMPLIFIX

Among the advantages of the joint are the facts that the pipe needs no preparation and that any slight discrepancies in the lengths can be taken up within the union without affecting its tightness or stressing the pipe. A ¼in. bore union of this type, on copper pipe, No. 19 gauge, has been tested by the National Physical Laboratory and showed no sign of distress when the pipe itself burst at a pressure of 2·06 tons per square inch.

CAMBRIDGE INSTRUMENT COMPANY, LTD.

Apparatus for automatic temperature control was shown by the Cambridge Instrument Company, of 45, Grosvenor-place, S.W. 1. It is capable of making and breaking currents up to 10 ampères at 250 volts without the use of an intermediate relay, and may be used in conjunction with a thermo-couple resistance thermometer, Féry telescope, or other temperature measuring devices. Normally, the apparatus works upon the potentiometric principle, but when used with electrical resistance thermometers it is connected in the form of a Wheatstone Bridge. A galvanometer forms the sensitive detecting element, the balanced or null position of the pointer being adjusted by a rheostat to correspond with the temperature at which control is desired. When any deviation from this temperature occurs, the pointer is deflected and by means of a mechanical device the deflection is caused to tilt a mercury tube, so as to break or make electric contacts controlling the supply of heat. The power for operating the switch mechanism is obtained from a small driving motor designed for A.C. or D.C. operation. When used in conjunction with thermo-couples, the standard apparatus can be used for controlling temperatures at any point over the ranges of 0–800 deg. Cent., 0–1200 deg. Cent., and 0–1400 deg. Cent., but the instruments can be supplied for practically any other range from —200 deg. Cent. up to 1700 deg. Cent. In apparatus used with thermo-couples variations in cold junction temperatures are automatically compensated. The accuracy of the regulation can be gauged from the fact that an instrument having a range of 0–1000 deg. Cent. will operate the controlling switch when the temperature deviates from the desired point by only 1·5 deg. Cent.

Among other exhibits were Cambridge humidity indicators and recorders. The ordinary method of determining humidity is by comparing the readings of wet and dry bulb thermometers, but in order to obtain the percentage relative humidity from these readings, it is necessary to have recourse to tables or calculations.

The outfits that were shown, however, possess the advantage that readings are obtained directly in terms of percentage relative humidity, no calculations or tables being required. Moreover, by the use of a special form of sensitive element, considerably greater accuracy and sensitivity in detecting small changes in humidity are secured. In each outfit the wet and dry bulb temperatures are measured by means of electrical resistance thermometers operating upon the same principle as the firm's distance thermometers, which embody a modification of the Wheatstone bridge. The sensitive element comprises two identical long spirals of platinum wire encased within a sheathing of special construction, the arrangement being such as to secure exceptionally rapid response to changes in temperature, conduction errors being eliminated. One of the spirals serves for measuring the "dry bulb" temperature, while the other is fitted with a fabric sleeving which is thoroughly wetted before use. In this way a large evaporative surface is obtained in intimate contact with the sensitive thermometer element which has a small total mass. Elaborate tests are said to have proved that for any given humidity this form of thermometer element gives a greater temperature difference between the wet and dry thermometers than is otherwise obtained. The two thermometers are mounted together on a common shaft, which is extended to form a convenient handle.

In the portable indicating outfit shown in Fig. 41, the wet and dry thermometers are connected up to an indicator mounted in a compact portable case, which also accommodates a switch, a rheostat, and the battery for supplying the current in the Wheatstone bridge circuit. The indicator is provided with two scales, showing respectively the dry bulb temperature and the percentage relative humidity. The switch is provided with four positions—"Off," "Test," "Temperature," and "Humidity." When in the "Off" position the indicator is disconnected. By moving the switch to "Test" a resistance of known value is connected in circuit, and the pointer should then be deflected to a definite reading, marked in red on the scale. If necessary, the pointer can be adjusted by means of a simple "zero adjustment." When the switch is set to "Temperature," the dry thermometer only is connected up and the temperature is read on the lower scale of the indicator. By rotating

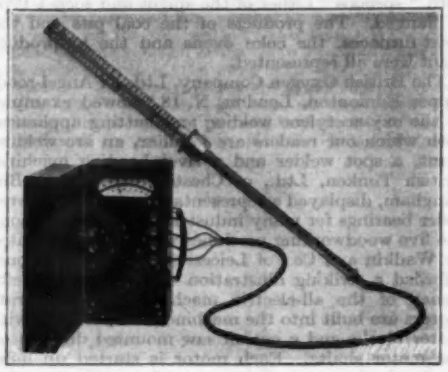


FIG. 41—PORTABLE HUMIDITY METER—CAMBRIDGE

a large circular dial concentric with the switch, so that the scale around this dial is set to this temperature a circular rheostat in the Wheatstone bridge circuit is adjusted, so as to introduce automatically the necessary correction in the humidity readings for that temperature. The switch is then turned to the "Humidity" position, when both wet and dry thermometers are connected up in such a way that the galvanometer pointer is controlled by the difference in the two temperatures. Since the galvanometer sensitivity has previously been adjusted by the rheostat in relation to the dry bulb temperature, the deflection can be read directly on the upper scale of the indicator in terms of percentage relative humidity.

A recording outfit is also made, in which the correction for variations in the dry bulb temperature is automatically effected by means of an independent relay mechanism, thus enabling the recorder chart to be calibrated to read directly in terms of percentage relative humidity.

DONOVAN AND CO.

An extensive display of electric control gear was shown by Donovan and Co., of Safuse Works, Northcote-road, Stechford, Birmingham. The exhibits consisted of push-button A.C. and D.C. control gear, and other A.C. control gear, D.C. starters and resistance gear, ironclad fuse and switchgear, open type switchgear, and "Solink" isolating links. A neat "across-the-line" starter, which may be operated by push buttons in the lid or from a number of positions by means of small push-button boxes, was shown in operation. An ingenious overload relay, which depends on the heating of a small resistance coil having approximately the same heating and cooling characteristics as the motor, is provided, and as no thermal strips are employed, distortion and alteration of the setting is avoided. Provided the correct heaters are installed for the motor, complete over-load and single-phase operation protection are provided, and it is said that nothing can alter the setting unless an alteration is required. Among other A.C. control gear was a manually operated single-phase resistance starter, suitable for repulsion induction motors. D.C. starter and resistance gear was represented by a collection of D.C. manually operated starters and regulators of different types, including potentiometers, combined shunt and series starter regulators, &c.

Two dimmers of outstanding interest were shown. One was completely enclosed, but was adequately ventilated, whilst the other was a cinema dimmer, designed for through wall operation with individual and master control, this being shown in operation on banks of coloured lamps. The wire-wound, threaded porcelain-bobbin resistances have always been embodied in this firm's starters, regulators, &c., and examples of these resistances were on view. Among the industrial switch and fuse gear exhibits was a six-way switch and fuse board for lighting purposes, which can easily be made water-tight. A collection of fuse boards, including 80 and 100-ampère boards, was shown. Ironclad change-over switches were exhibited in sizes ranging from 15 to 300 ampères. "Safuse" switch fuses were also exhibited, and three-phase four-wire switches designed for switching the neutral or otherwise. Donlock 600-volt switch sockets and plugs were shown in sizes up to 100 ampères, and a new light weight design rated at 10 ampères was shown for the first time.

An open type switchboard, together with a collection of fuses and knife switches served to show that the firm's open type switchgear products comprise every size of gear from 15 to 3000 ampères. Among the insulated handle isolating links known as "Solinks" was a patented type with a screw and wedge expanding contact. The standard ratings of these isolating links are 40 and 130 ampères, but they have been made for currents up to 1000 ampères.

M. AND C. SWITCHGEAR, LTD.

Switchgear and control gear suitable for almost every industry was exhibited by M. & C. Switchgear, Ltd., of Kirkintilloch, Glasgow. The firm's oil circuit breaker gear is completely metal-clad, and everything, including the trip coils, is immersed in oil. Hence there is no risk of the calibration tubes and time lags rusting, with the consequent failure of the breaker to trip. The examples of breakers shown included the maker's usual industrial pattern and a fireproof pattern for use where inflammable gases may be met with, such as in collieries, gasworks, oil depôts, &c. There was a four-panel industrial L.T. draw-out board, a three-panel L.T. flameproof draw-out board, and a flameproof draw-out pillar rated at 100 ampères and 3300 volts, the latter being a typical example of the firm's H.T. gear. There were two floor-mounted industrial non-draw-out oil circuit breakers, one rated at 60 ampères and the other at 100 ampères. These breakers are single-break switches, and have been designed to meet the demand for an oil breaker built on the same sound lines as larger oil switches, and they are said to serve as ideal "straight-on" starters for squirrel-cage motors. Air break ironclad switchboards that are built up on the unit system and added to as required were also on view.

Among other motor starting gear was a starter pillar incorporating a rotor starter and an oil break circuit breaker. The contacts in the cast iron case are at the top and under clean oil and free from the sludge which collects at the bottom of tanks. The interior of the switch is accessible without disconnecting the cables.

A push-button starter which was shown has been designed for small squirrel-cage motors and comprises a contactor with thermal relays, the start and stop pushes being incorporated in the enclosure. D.C. starters, including a starting panel, comprising a weatherproof starter and iron-clad switch and fuse on a pedestal for floor mounting were shown, as were gate end switches and circuit breakers.

GAS FURNACES.

On one of the combined stands of the City of Birmingham Gas Department a number of gas-heated furnaces by different makers were on view, most of them under working conditions. Among them there was a furnace by Brayshaw Furnaces and Tools, Ltd., of Mulberry-street, Hulme, Manchester, measuring inside the working chamber 2ft. wide by 1ft. high by 3ft. long. Its chief peculiarity lies in the fact that the fore-plate or work-shelf outside the door has a vertical movement on slides. When the door is lowered to close the furnace, it depresses the plate a few inches, so that the door makes a good wide contact joint with the furnace front and leakage is minimised. When the door is raised the plate comes up with it until the hearth level is reached, and is then locked conveniently for loading or unloading the charge. A sliding damper is connected with the gas and air proportioning valve, regulating the flue outlet in accordance with the gas consumption. A butterfly damper automatically opens and closes to correspond with the closing and opening of the door. Auxiliary gas inlets are fitted to give a reducing atmosphere, and there are recuperators to transfer the waste heat of the flue gases to the incoming air.

Davis Furnaces, Ltd., of Luton, had a high-temperature forging furnace of the Revergen type, in which the recovery of the waste heat is effected by the change-over system, and work can be carried on with a minimum of scaling.

The Incandescent Heat Company, Ltd., of Bir-

* No. IV. appeared March 11th.

THE FINCHLEY ROAD DEPOT OF CADBURY BROTHERS ON THE L.M.S. RAILWAY

mingham, had one of its standard types of combination recuperative furnaces of a comparatively small size. This furnace is representative of the natural draught type of low-pressure gas-heated furnaces for the general works heat-treatment operations of annealing, normalising, carburising, and reheating. This furnace is fitted with automatic control of gas supplies and damper by the Foster Instrument Company.

Wm. Allday and Co., Ltd., of Birmingham, had some small gas-heated stoves for such purposes as heating soldering irons and furnaces for heating brass billets, while British Furnaces, Ltd., of Chesterfield, had a small forge furnace heated on the surface combustion principle. The same principle was also demonstrated by the Metropolitan Fuel Company, Ltd., of London.

Other Exhibits.

R. H. Neal and Co., Ltd., of Plant House, Ealing, London, W. 5, showed a mobile crane of the type which we described in connection with the Public Works Exhibition, at work in the grounds. This type is driven by a Ford petrol engine and is capable of lifting 2 tons at 14ft. radius, while the maximum radius with ¼ ton is 22ft.

G. B. Parkes, Ltd., of Halesowen, Birmingham, demonstrated some machines for testing pipes, pipe fittings, &c., for tightness, by means of compressed air. We described the principle of the apparatus in connection with the last Fair, but since then the idea has been elaborated to include more complicated shapes. The fitting is clamped in a jig between rubber pads that close the openings, and the interior is then subjected to an air pressure of 100 lb. per square inch. It is immersed in water and any bubbles naturally show that the fitting is faulty.

Thos. Firth and John Brown, Ltd., of Sheffield, showed a new type of steel, known as "F.D.P., which has been introduced to meet conditions under which the proper heat treatment of bulky fabricated and welded plant is impossible owing to the lack of facilities in foundry capacity. This steel, when fabricated, needs no heat treatment and is said completely to avoid all complications in the way of disintegration at both heavily manipulated points and welded joints. Turton Brothers and Matthews, Ltd., of Wentworth-street, Sheffield, showed a new steel, which they have named "Flygo Megiston." It is claimed to be a super high-speed steel and will tackle difficult machining jobs where ordinary high-speed steel would fail. The United Steel Companies had a number of show cases illustrating the various steel products of the allied companies, Frodingham and Appleby, the Workington Company, S. Fox and Co., D. Doncaster and Sons, and Steel, Peech and Tozer. There was on this stand a complete tramway bogie, the whole of the various parts of which were built from steel supplied and worked by the United Steel Companies; various products from the United Strip and Bar Mills; and some "Phœnix" free cutting steel, which is said to be pre-eminent in fast repetition machine work. British Rolling Mills, of Tipton, Staffs., had a press at work demonstrating the ductility of their "Brymill X" steel, which can be drawn to very considerable depths without intermediate operations; and some steels which have been developed to take the place of 3 per cent. nickel steel at a considerable reduction in cost. One of these steels, for instance, has an ultimate tensile stress of from 45 to 50 tons per square inch, an elongation on 2in. of from 24 to 34 per cent., a reduction in area of from 50 to 60 per cent., an Izod impact test of 40 to 50 foot-pounds, and a scleroscope number of from 80 to 90. N. Hingley and Sons, Ltd., of Netherton Ironworks, Dudley, was one of the few firms showing specimens of wrought iron work for such purposes as railway couplings and sling chains, which have to withstand shocks. There were also on view various forgings in steel, such as rings and anvils.

The Staveley Coal and Iron Company, Ltd., near Chesterfield, had a stand designed to demonstrate the multifarious products of its works. The pipes of iron, centrifugally spun in sand moulds, we have already described. There were also iron pipes, cast vertically, both plain and concrete lined, with "specials" either of the spigot and socket type or flanged. The products of the coal pits and the blast-furnaces, the coke ovens and the by-product plant were all represented.

The British Oxygen Company, Ltd., of Angel-road, Upper Edmonton, London, N. 18, showed examples of the oxy-acetylene welding and cutting appliances with which our readers are familiar, an arc welding plant, a spot welder and a rivet heading machine. British Timken, Ltd., of Cheston-road, Aston, Birmingham, displayed a representative range of tapered roller bearings for many industrial purposes. Among the five woodworking machines which were exhibited by Wadkin and Co., of Leicester, an electric tenoner afforded a striking illustration of the increased efficiency of the all-electric machine. Five separate motors are built into the machine, which is fitted with cutter blocks and a cut-off saw mounted directly on the motor shafts. Each motor is started up independently by push buttons, whilst a master stop button cuts off the current to all the motors simultaneously. The adoption of the electric drive in this case has abolished a complicated system of belts hitherto used in this type of machine, and also reduced the floor space by practically one-half. Maintenance charges have also been materially reduced, and in practice it is found that the power costs of the electric machine are considerably less than those of any other form of drive.

Royles, Ltd., of Irlam, near Manchester, exhibited an apparatus for chlorinating water, similar to that which we described last year, some calorifiers and radiators fitted with Row tubes, together with a great variety of steam and water fittings. On the stand of Gibbons Bros., Ltd., of Dudley, there was a little office built entirely of fire-brick, with windows of silica segmental retort sections, surrounded by specimens of various refractories. H. W. Ward, of Dale-road, Selly Oak, Birmingham, had an exhibit consisting of small tools suitable for attaching to capstan and turret lathes. Haslam and Newton, Ltd., of Derby, showed refrigerating machinery, comprising a large duplex ammonia compressor, electrically driven, a single-cylinder compressor, and an automatically controlled methyl-chloride plant, together with some electric resistance welders and other electrical plant.

A New London Railhead Distribution Depot.

Increased business, coupled with present-day economic conditions, has created growing demands on the daily road delivery service which has been developed by Cadbury Brothers at that firm's present London depôt at Camden goods station, and it recently became obvious that a move would have to be made to larger and more up-to-date quarters. A survey of rail-connected sites available on the L.M.S. was therefore made, and a situation chosen upon which the building illustrated in the accompanying engraving was erected. The plans of the new depôt were prepared by the chief engineer's department, L.M.S., in consultation with Cadbury Brothers' transport and engineering experts, and incorporate the joint experience of the two concerns. The depôt is situated at Finchley-road goods station.

The depôt is a two-storey building, so constructed that it allows for the addition of a third storey if such should be required in the future, and comprises a steel-frame structure with patented hollow floors throughout. It provides approximately 46,000 square feet of office and warehouse accommodation. The external finish is of multi-stock facing bricks. The floors of the stock-rooms have a granolithic finish, and to stand up to the continuous trolleying of heavy stocks on bogeys with small steel wheels, cast iron trolley tracks, 6ft. wide, have been provided throughout the building. The offices are situated in a separate block on the west side of the building, and underneath the offices on the ground floor dining rooms are provided for the staff. The new depôt is situated on the direct L.M.S. goods rail route from Birmingham to London, enabling stocks of freshly made cocoa and confectionery to be despatched from Bournville daily for distribution throughout the whole of the London delivery area. The products of the firm are sent off from the main factory at Bournville in wooden containers, which facilitate the handling of the goods from the workrooms at Bournville right through to the stock-rooms in the new depôt. The transport of stock from Bournville to the new depôt will necessitate the use of a daily special train.

Great care and constant supervision are exercised to ensure that the firm's products stored in the new warehouse are kept in ideal conditions, and to this end the stock-room temperatures are controlled by means of a plenum heating system. The incoming air, drawn through a battery of steam-heated tubes, is warmed to maintain a constant temperature of 55 deg. inside the stock-rooms although the outside atmosphere may be at freezing point. Humidity conditions are also controlled.

A mixed office staff of male and female clerks will be necessary to deal with the administrative side of the depôt, while the stock-room and delivery side will employ approximately fifty warehousemen.

For road delivery in the London area Cadbury Brothers have contracted with Thomas Tilling, Ltd., a firm which has been closely connected with the company in the development of its delivery service from the London depôt for a number of years.

An All-welded Steel Framed Building.

On Thursday, March 10th, a party of prominent structural engineers, architects, and consulting engineers visited the Walthamstow works of Murex Welding Processes, Ltd., to inspect the company's factory extension, consisting of an all-welded steel-framed building, in the course of erection. The visit was arranged under the auspices of the British Steelwork Association, and the party included representatives of the British Standards Institution, the Sub-committee on Welding, and engineers connected with important steel construction firms. The structure has been designed and priced on a strict competitive basis, and every effort has been made to obtain all the benefits of electric welding. The advantages claimed for the structure are lightness and minimum section of every component, the elimination of the usual gusset plates, and the absence of noise during erection. Covering an area of 37,000 square feet, the building is 231ft. long and 160ft. wide, and is divided into thirty-three bays. As the lay-out of the machinery necessitates the provision of a clear floor space, a 160ft. span roof has been adopted. A view of the building in the course of construction is shown in Fig. 1; Fig. 2 shows one of the main girders; Fig. 3 gives details of the welded construction.

There are 22 ordinary and 110 cantilever type trusses, spaced at 13ft. 2in. centres, suspended from six girders supported on twelve braced columns. The total weight of the steel work is approximately 132 tons. The building does not contain a single rivet, and the only bolts used are for column foundations, the anchor plates to wall on end trusses, and those required for securing the wooden ridge purlins to the top boom of the girders. The twelve panels of the main 160ft. girders, which are 10ft. deep, are built up from two 9in. by 3½in. channels, spaced 13in. apart, and two 7in. by 3½in. channels forming the top and bottom booms respectively, the booms being bent to template to give a camber of 5in. in the total length

ALL-WELDED STEEL FRAMED BUILDING AT WALTHAMSTOW

MUREX WELDING PROCESSES, LTD., LONDON, ENGINEERS

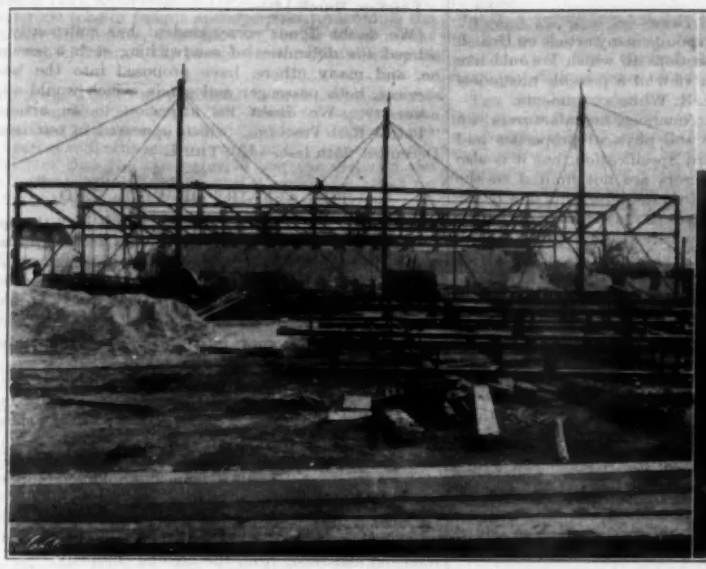


FIG. 1—WELDED STEELWORK IN COURSE OF ERECTION

FIG. 2—160-FOOT WELDED GIRDER

before welding on the struts. Spaced at 13ft. 2in. truss centres, the box type struts consist of four 2in. by 2in. by ¼in. corner angles, stiffened by 4½in. by ¼in. flat bottom plates. At the centre of the span the ties are made up from 2in. by ¼in. flats, and increase in size to 6in. by ¾in. near the columns, in order to carry the extra stresses. The booms are fitted with gusset plates, and landing cleats at each end, and bear on angle cleats welded to the column flanges. Owing to transport difficulties, the girders left the workshop in five sections, and each section was set up on the site in its respective position, the camber being checked in each case by means of a dumpy level before welding up the butt joints, and finally lifting into position. As shown in Fig. 3, the webs of the booms were drilled to take temporary fish-plates, and by means of drifts each section was lined up and a good butt joint was obtained. The top and bottom flange cover plates were then welded in position, after which the temporary fish-plates were removed and replaced by permanent cover plates, which were welded to the web and made to obscure the holes.

Each girder weighs 8·5 tons and supports a total load of 47 tons, made up as follows :—

Weight of girder say 8·5 tons—12 panels = 0·7 ton per panel.

	Top boom.	Bottom boom.
Dead load per panel from girder, tons	0·35	0·35
Dead load per panel from truss, tons	0·23	0·91
Dead load per panel from truss, tons	0·20	1·05
Wind load per panel from truss, tons	0·19	0·90
Total	0·97	3·21
Say	1·00	3·25

A set of levels was taken after the girder had been welded in position on the columns, the results showing a deflection of 1¼in. Further readings were taken after the trusses had been erected, and an additional deflection of 1¼in. was noted, this giving a total deflection of 2½in., and reducing the initial camber at the centre to 2½in. The calculated deflection for total loads, including the above, is about 4in.

The roof trusses are of the cantilever and ordinary type, and are in two sizes, the largest weighing approximately 6 cwt. and having a span of 33ft. At the truss shoe there is a 9in. by 7in. base plate, which is anchored to a concrete pad stone on the side walls by two bolts. An angle is welded to the extension of the tie to locate and carry the pressed steel gutters, the other ends of the truss being welded to the top and bottom girder booms respectively. The struts and bracings of the truss were welded direct to the tie and rafter angles to the exclusion of the usual gusset plates. The smaller cantilever trusses weigh 3 cwt., and have a span of 16ft. 6in., the connections to the girder being the same as described, but at the shoe there is a base plate which is common to the shoe of the opposite truss suspended from the next girder. Angle bars to carry the gutters are welded to rafters forming the valley, as shown in Fig. 3. Flats are also welded to the top of the rafters to locate the channel purlins, and angle cleats are provided for connecting the angle purlins carrying the glazing.

The loads on the trusses are given as follows :—

Dead loads (large trusses)—

Snow	5·0 lb.
Purlins	1·6 lb.
Sheeting and glazing	3·1 lb.
Steel	1·5 lb.
Total	11·2 lb./sq. foot

Total dead load = 455 sq. feet by 11·2 lb. per sq. foot = 2·26 tons.

Wind load, 15 lb. sq. foot.

$$\text{Normal wind load} = \frac{15 \times 2 \sin \alpha}{1+\sin^2 \alpha} = \frac{15 \times 2 \times 0{\cdot}264}{1+0{\cdot}264 \times 0{\cdot}264}$$

$$= 7{\cdot}4 \text{ lb. per sq. foot.}$$

Say 8·0 lb. per sq. foot.

Total wind = 455 sq. foot × 8 lb.

= 1·63 tons.

Dead load (small trusses) = 11·2 lb. per sq. foot.
Wind load (small trusses) = 15 lb. per sq. foot.
= 11·2 lb. per sq. foot normal.

Total dead load : 18·5 × 13·16 × 11·2 lb./sq. ft. = 1·25 tons
Total wind load : 18·5 × 13·16 × 11·2 lb./sq. ft. = 1·25 tons

The columns each weigh approximately 1 ton, and are fabricated from 13in. by 5in. R.S.J.'s, 25ft. 4½in. long, and have angle cleats welded at the top to locate the top boom and gusset plates welded to the flanges, 10in. down, to receive the bottom boom of the girder. The flange gussets welded to the base are extended to accommodate the raker angles forming the column wind bracing. The rakers extend from the base of the column, and are welded to gussets provided about 7ft. from the end of the bottom boom. Angle bracings are also welded to these boom gussets and at their other extremities they are connected to the top boom column gussets. Batten stiffeners are equally spaced and welded across the raker and bracing angles. The columns were delivered to the site complete with the welded gussets, but without the rakers, which were not welded in position until the girder was carrying its full load, and the initial camber had been reduced. Each column is welded at the bottom to a base plate, 1ft. 11in. by 1ft. 7in. by ¾in., and, in addition to the flange gussets mentioned, it has two web gussets.

The total weight of the purlins is approximately 34 tons, and the sheeting purlins are fabricated from 4in. by 2in. channels, which are fixed on the trusses by small flats on the rafter before welding in position. Welded fish-

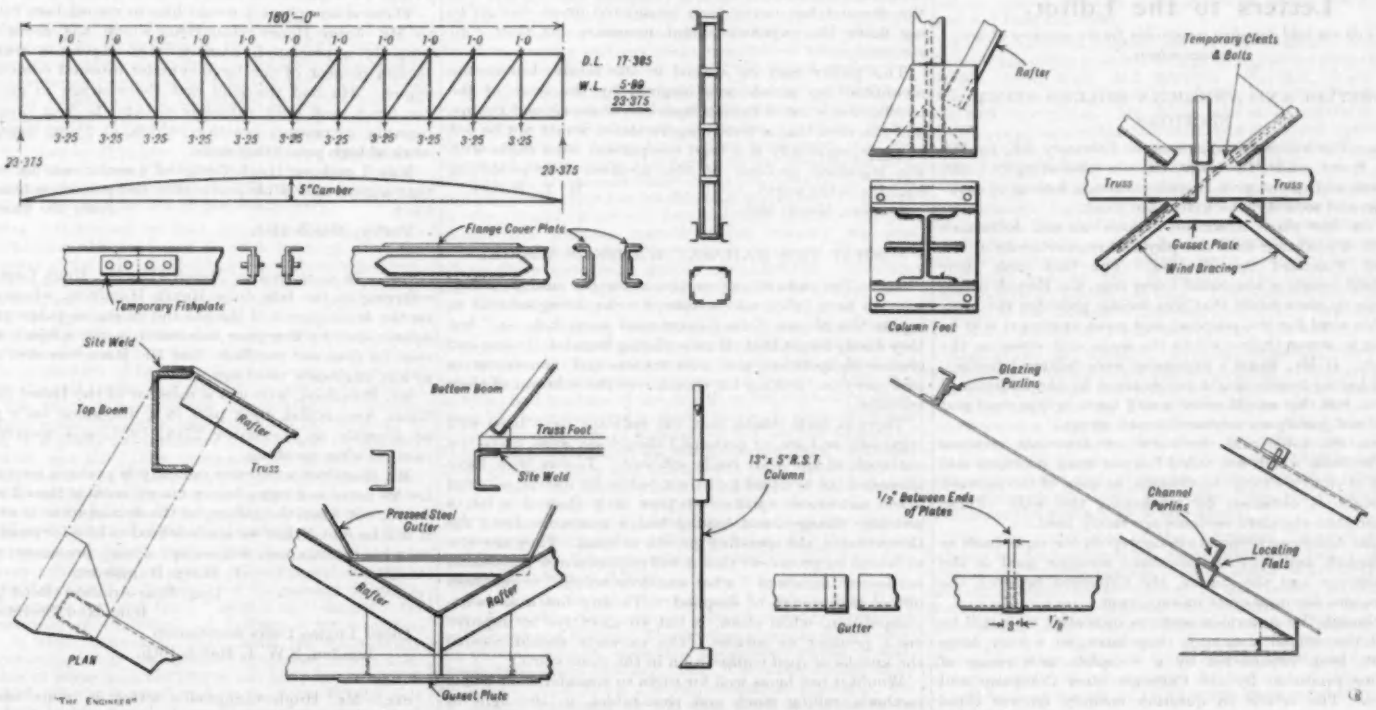


FIG. 3—DETAILS OF WELDED CONSTRUCTION

plates connect each purlin to form a continuous run the full length of the roof. The main glazing purlins consist of —(*a*) 5in. by 3in. by $\frac{7}{16}$in. angles drilled on the 3in. flange to take the sheeting, and having 2in. by 2in. by $\frac{1}{4}$in. mitred cleats welded on the 5in. flange and suitably spaced to carry the tops of the glazing bars; (*b*) 4in. by 3in. by $\frac{7}{16}$in. angles holed on the 3in. flange to carry the bottom glazing bars and having a 2in. by 2in. by $\frac{1}{4}$in. continuous angle welded on the 4in. flange to carry the sheeting.

The diagonal wind bracing at chord level is in the form of a hollow square, and runs the full width of the building between girders 1–2 and 5–6 on the two sides, and along the gables on the ends. A single longitudinal tie is connected to the shoe gussets of all the trusses between each girder. All the bracing members consist of 3$\frac{1}{2}$in. by 2$\frac{1}{2}$in. by $\frac{1}{4}$in. angle, and the gusset plates are $\frac{1}{4}$in. thick. The gusset plates coupling the shoes of the cantilever trusses are extended to accommodate the diagonal bracings which converge to this central point.

The other ends of the diagonal members are welded to the top flange of the bottom boom channels. Each bracing has a small temporary angle cleat lightly tacked about 12in. from one end. The cleat is drilled to take a bolt, sufficiently long to project through a similar cleat on the member immediately opposite. The other end, in the case of the diagonals, is welded in its correct position on the bottom boom of the girder, and the initial stress is obtained by pulling up the bolt at the free end before finally welding in position on the shoe gusset described. The temporary cleat is then removed and used again in a similar manner.

The pressed steel gutters have a total length of 1120ft. All the gutters are pressed from $\frac{1}{16}$in. sheet. The valley gutters and wall gutters have a girth of 27in. and 24in. respectively. They are fabricated in about 13ft. 6in. lengths, and are connected by a spigot and socket type joint. A cover plate, 3in. by $\frac{1}{4}$in., is welded at one end of each length on the underside, and projects about 1$\frac{1}{2}$in. to form the socket for the next length; the other end of the gutter, which forms the spigot, being welded to the cover plate after erection to give a water-tight joint. The valley gutters rest on the supporting angles described in connection with the trusses, and are tacked to flat bar supports, 1$\frac{1}{2}$in. by $\frac{7}{16}$in., which are bent to shape and welded to the lower channel purlins. The camber in the girder is sufficient to give the necessary fall for the gutters.

Practically the whole of the welds, with the exception of the butt joints on the girder booms, are $\frac{1}{4}$in. fillet welds, and not less than 1$\frac{1}{2}$in. long on any joint. The design basis for welds was taken as 0·8 tons per 1in. run of $\frac{1}{4}$in. fillet, and numerous tests were made on typical joints.

The electrodes used are of the company's fully fluxed alloying machine-made "Medex" type, which is a free-flowing, good, all round, general purpose electrode, giving relatively high tensile strength and elongation, and is suitable for overhead and vertical welding.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

BRITISH AND AMERICAN ROLLED STEEL SECTIONS.

Sir,—The article in your issue of February 5th, by Mr. B. L. Hurst, under the above title, is misleading in many respects and might give British makers a feeling of satisfaction and security which does not exist.

In the first place, American makers can and do furnish steel in accordance with the physical requirements of the British Standard Specification. The fact that their standard tensile is somewhat lower than the British is due entirely to their belief that this tensile provides the most suitable steel for the purpose, and most engineers will be willing to stress their steel to the same unit stress as the British. If Mr. Hurst's argument were followed further, a still higher tensile might be obtained by the addition of carbon, but this would cause a still more brittle steel and would not justify an increase in unit stress.

Both the table and the curve of American sections include those which are rolled heavier than standard and which obviously cannot be efficient, as most of the increase in weight is obtained by thickening the web. These heavier than standard sections are rarely used.

If the American sections are figured on the same basis as the British and only the standard sections used in the calculations and the curves, the difference between the two ranges becomes quite unimportant.

Although the American sections indicated may still be called the official standard, they have, to a very large extent, been superseded by a complete new range of sections produced by the Carnegie Steel Company and others. The article in question entirely ignores these sections, which are far more efficient than either the old American or the new British. It states that broad flange beams which are specially designed for stanchions have been omitted, but these Carnegie sections are not all stanchion sections, as a great many of them are used almost exclusively as beams. These sections have two great advantages over any predecessors, in that all sections can be rolled heavier than standard without impairing the efficiency. This is done, of course, by increasing the flange thickness as well as the web thickness. In fact, the heavier than standard sections in this range are always as efficient and in most cases more efficient than the standard section. This range of sections, even taken at the lower unit stress suggested by Mr. Hurst, is practically as efficient as the British, while if they are compared on the same unit stress basis the difference is most marked in favour of the American. They have the additional advantage that they can be obtained up to 36in. deep.

It might be mentioned that a paper on this subject was read some time ago before the Institution of Structural Engineers, which attracted much attention. It was then urged that British makers should review the position in consequence of their unfavourable situation.

Bearing in mind the several facts enumerated above, it would only seem fair to have the position more clearly understood. H. R. White, M.I. Struct. E.

London, March 8th.

Sir,—There are one or two points in my article on British and American rolled steel sections to which I would like to give greater emphasis, in view of a possible misunderstanding arising from Mr. H. R. White's comments.

It is fully admitted that American manufacturers can —and do—furnish steel to the physical properties laid down in the British Standard Specification, but it is also true that British manufacturers are not limited to the range of 28–33 tons tensile, if the requirements of a buyer and the price he is prepared to pay justify a higher standard. The article was concerned only with the commercial steels specified in the standard specifications of this country and the United States.

American engineers may be willing to use a unit stress for their lower tensile steel equivalent to that applied to a higher tensile, but do so only at a definite sacrifice in the safety factor.

As for the sections chosen for comparison, special sections rolled by individual makers were omitted, the comparison legitimately being based on those sections which presumably can be obtained from all makers. It was not my intention to make a survey of all aspects of American practice and to include Carnegie and other special beam sections outside the standard range.

A multiplicity of sections is not considered an advantage, and the interests of the consulting engineer are best served by a restricted and standard list which will ensure efficiency, prompt delivery, and their purchase from any maker, no matter in what part of the country his plant may be situated.

Mr. White deprecates the inclusion of those American standard sections which are rolled heavier than the minimum weight, with a consequent loss of efficiency. As he states that these sections are rarely used, it seems strange that the Americans should include for so many standard sections a range of four specific weights. So far as the larger sections are concerned, I feel sure that the heavier weights will be in fairly constant use. Even if the graph of efficiencies is constructed on the basis of one standard only for each depth of section, the characteristics of the graph are substantially the same.

Mr. White refers at considerable length to the advantages of broad flange beams. These are undoubtedly useful sections, particularly for stanchions, and obviate a considerable amount of fabrication, but broad flange beams are not used to any great extent in this country and the demand has never been considered great enough to lay down the expensive plant necessary for their construction.

This policy may be altered in the future, but in the meantime my article was inspired by the issue of the excellent new list of British Standard Channels and Beams, and the view that a timely appreciation would not be out of place, especially if a brief comparison were made with the standard sections of the greatest steel-producing country in the world. B. L. Hurst.

London, March 10th.

WHAT THE RAILWAY WANTS IS VISION.

Sir,—The railway companies, after the annual audit, seem to have fallen into a state of coma, being content to repeat the phrase "the Government must help us," but they surely forget that all are suffering from less income and greater competition, and most traders and manufacturers just carry on, seeking for themselves the solution of their troubles.

There is little doubt that the railways have been well organised and are, or perhaps I should say were, up to the outbreak of the war, really efficient. To-day they have alienated the sympathy of their public by having adopted a too autocratic spirit—last year they thawed a bit, a welcome change—and having had a guarantee from the Government, the spending got out of hand. They are now so bound by precedent that it will require a new generation without trammels of "what was done before" to get them out of the slough of despond. To any but a socialist, competition, when clean, is but an incentive to improve one's product or service. The railways should receive the knocks of road competition in the same spirit.

Would it not be as well for them to consider their whole methods, rolling stock and time-tables, in the light of modern requirements? Of what use is a huge train of 300 to 400 tons travelling a few times a day to the general public? They want a miniature omnibus service, so that they can come out of their homes, jump on a vehicle to Leicester, York, or elsewhere, without getting out a time-table that needs fifteen minutes or more to look up several pages to ascertain the times of the departure and arrival. Each rail coach to-day costs from £1500 to £2000. If they would take their eyes off electricity, which would necessarily increase capital account, and look to the petrol engine, they could have self-propelling cars at the same cost as their present rolling stock, and could run ten of such coaches per hour instead of one train every two hours. The cost would be similar in almost every respect, and the public would rise to the facilities provided. The present road coach could be made to run on rails at a higher speed than on the road. With almost complete freedom from risk and high speed the public would support the railways and the companies would have their public friendly.

Places like Birmingham, Coventry, Leicester, Nottingham, Bristol, Southampton could all be reached from London, and thence to London in less time than the present trains and, what is more to the point, people could arrive at the termini at any moment, knowing that there would be a train within ten minutes. Surely it should be worth the while of one of the railways to try out such a service. A Regular Rail Traveller.

London, March 12th.

[We doubt if our correspondent has sufficiently considered the difficulties of sandwiching such a service as he, and many others, have proposed into the heavier services, both passenger and goods, which would still be necessary. We direct his attention to an article on "Petrol Rail Traction," which appeared in our issue of December 25th last.—Ed. The E.]

THE AFFAIRS OF A.G.E., LTD.

Sir,—You gave in your issue of March 11th the speech made by Sir Gilbert Garnsey at the twelfth ordinary general meeting of Agricultural and General Engineers, Ltd.

In the speech to A.G.E. shareholders he referred to my company—Davey, Paxman and Co., Ltd.—as having "outside debenture holders interested in the concern, and the value of your interest as shareholders partly depends on what action may be taken by them."

A receiver and manager has been appointed by the Court to carry on the business of my company in the ordinary way and to protect the interests of the debenture holders.

I would like to point out that since Agricultural and General Engineers, Ltd., became the holding company of my company's ordinary shares, my company has contributed a very considerable sum in dividends, expenses, and loans to A.G.E., Ltd., and they have never had any financial assistance from the holding company.

My company now find themselves in their present position owing to advances made to Agricultural and General Engineers, Ltd., and their being a debtor to my company for a large amount at the time of the appointment of Sir Gilbert Garnsey as receiver and manager to A.G.E., Ltd. William Paxman.

London, March 15th.

JOHN HENRY HAMILTON.

Sir,—Internal combustion engineers throughout the world will read the letter of Mr. Hugh Campbell in your current issue with feelings of pleasure and affection. He is probably right in referring to himself as the only survivor of those who laid the foundation in this country for the gas and oil engine. As one closely associated with these early developments, I do not recall another name, unless Mr. A. R. Bellamy, of Stockport gas engine fame is still living, his work dating back into last century

There is one point I would like to record here relating to Mr John Henry Hamilton, which has never been properly appreciated, namely, that Hamilton was the British pioneer of the large-cylinder internal combustion engine. He had the skill and the courage to go right out for it, and built cylinders of three to four times the capacity of current practice, which, in those days, was work of high pioneering merit.

May I endorse Hugh Campbell's sentiments by saying that a great and noble personality has passed on from this life? John D. Troup.

Purley, March 14th.

Sir,—In your issue of March 11th Mr. Hugh Campbell, referring to the late John Henry Hamilton, whose work on the development of the gas and oil engine is known and appreciated by everyone interested in the subject, states that he does not recollect that Mr. Hamilton ever spoke at any engineers' meetings.

Mr. Hamilton, who was a member of the Diesel Engine Users Association, took part in a discussion on a paper as recently as November 27th, 1931, and received an ovation after speaking.

Mr. Hamilton's extreme modesty is perhaps responsible for his name not being better known outside the oil engine world, but when the history of the development is written, it will be found that we are indebted to him for much, and that his contribution will occupy a very prominent place.

J. Hope Harrison,
Eng. Rear-Admiral (Retd.),
Joint Hon. Secretary.

Diesel Engine Users Association.
London, S.W. 1, March 16th.

Sir,—Mr. Hugh Campbell's letter in your issue of March 11th revives interesting memories of early days in the history of the internal combustion engine. This prime mover appears to have had a peculiar fascination for north countrymen, for Mr. Hamilton and Mr. Campbell were evidently preceded in their journey south by Mr. James Robson, who brought his two-cycle gas engine, patented in 1879, to my firm, who manufactured it for a number of years. This engine, incidentally, provided me later with my first lesson in fitting and erection.

Then came Clerk from the Clyde and made his well-known experiment at Cornwall Works with his "flame" engine. In this the air was first compressed and ignited gas injected without explosion, giving exactly the early Diesel diagram.

During this long period Mr. C. W. Pinkney, whose name is also well known as having contributed largely to the early development of the gas engine, and particularly of the oil engine in the early 'nineties, collaborated, and still lives in well-merited retirement at Smethwick, close to the scene of his early labours.

Birmingham, March 16th. H. Lincoln Tangye.

Railway and Road Matters.

IT is claimed that the United States railways have established a new low record in fuel conservation by locomotives in 1931, an average of 119 lb. of fuel being required to haul 1000 tons of freight and equipment, including the locomotive and tender, a distance of 1 mile, which means a reduction of 2 lb. on the previous record, established in 1930.

THERE was a buffer stop collision in St. Enoch's Station, Glasgow, on Monday, March 7th, when an express from Girvan failed to pull up in time. The incident would not have been of sufficient importance to merit notice here, but for the fact that the same station was the scene of the worst buffer stop collision in this country, *i.e.*, that on July 27th, 1903, when sixteen passengers were killed.

THE Southern Railway Company's new Channel Islands steamer, the "Isle of Sark," built by Denny Brothers and Co., Ltd., will be put into service on March 18th. When the new boat for the Newhaven–Dieppe route, now under construction for delivery in 1933, is on her station and the rest of that fleet has been modernised by being converted from coal firing to oil fuel, the service will be performed by six vessels instead of eight. All the passenger vessels will then be oil burning and interchangeable for day or night service.

HEREIN, on December 25th, we announced that on the retirement of Mr. D. McLellan from the position of divisional engineer, Glasgow, L.M. and S., Mr. A. H. McMurdo, the permanent way assistant at headquarters, Euston, had been appointed to succeed Mr. McLellan. The vacant position at Euston has now been filled by the promotion of Mr. J. W. Melville, who was the son of Mr. William Melville, at one time an engineer on the Caledonian Railway, and later the chief engineer of the Glasgow and South-Western Railway, and, incidentally, the designer of St. Enoch's Station, Glasgow.

THE Ministry of Transport railway statistics for December have just been issued as a Stationery Office publication, price 2s. 6d. They show that, compared with December, 1930, the number of passenger journeys decreased by 5·3 per cent. and the receipts from passengers by 9·2 per cent. The coaching train miles totalled about the same. The tonnage of freight decreased by 5·6 per cent. and the receipts therefrom by 5·6 per cent. also. Freight train mileage was reduced by 3·9 per cent.; whilst an unsatisfactory feature was that the average train load fell from 130¼ tons, better operating methods were shown in the increase in the net ton-miles per engine-hour from 424¾ to 441¾.

THE Great Western Railway Company's report for the year 1931 shows that the gross receipts from railway working proper—*i.e.*, independently of such ancillary businesses as docks, steamboats, hotels, &c.—were £26,893,480, and the expenditure thereon was £21,809,167, as compared with £29,589,918 and £23,617,214 respectively for 1930. Thus the net receipts for 1931 were £5,804,312, as against £5,972,704. The maintenance of way and works was reduced from £3,646,564 in 1930 to £3,215,240; the maintenance of rolling stock from £3,975,306 to £3,604,442; locomotive running expenses from £5,459,550 to £5,139,835; and traffic expenses from £8,086,550 to £7,538,501. In the ancillary businesses the net receipts from steamboats of £12,685 fell to £6894 in 1931; that of £405,054 from docks dropped to £170,958; whilst hotels and refreshment rooms had an increase of £36,303 in business, but as expenditure was increased by £39,230, the net receipts of £49,407 in 1930 became one of £46,560 in 1931.

IT was satisfactory to hear from Sir Josiah Stamp, at the London, Midland and Scottish meeting, that the withdrawal of the Tilbury–Dunkirk cross-Channel services, of which that Company expected so much, was due entirely to bad luck and not to bad management. The abandonment of the gold standard reduced the amount to come from the land journey on this side, and, in the second place, the Government action in relation to the balance of trade and the imposition of tariffs strikes not only at the total of cross-Channel traffic, but also at the particular class of traffic for which this route was adapted and developed. The effect upon the traffic was such that the prospect of making it a really remunerative service was indefinitely postponed, and the L.M.S. company felt unable to give such facilities to the French company, owning the service, as would enable them to continue it upon existing lines. The service is to be transferred on May 1st to Folkestone, and will open a new Folkestone–Dunkirk route.

IF it were practicable to compile an estimate as to how many times a day, or a year, railway signal arms were put from "danger" to "clear" for the passage of trains, and afterwards restored from "clear" to "danger" for the protection of the trains; if, further, it were remembered, in this connection, that, with the exceedingly small percentage that are operated by power, this is done by means of wires from the end of the lever in the signal-box, which pass over small pulleys on posts by the side of the line, to the signal, it would come as a very great surprise to learn how rarely these signal connections fail. For that signal manufacturers and maintainers may take great credit. Failures do, of course, occur sometimes, but the apparatus is so constructed that failures are on the side of safety and there are, additionally, ample means for announcing a failure. Our file of accident reports show that since the opening of the present century there have been twenty-one cases of accident reported as due to failure of signals, and in every instance the fault was discovered. We have, however, now before us the report by Lieut.-Colonel Woodhouse of a derailment due to a signal being irregularly in the "clear" position, the cause for which was not indicated. This happened at Preston on the afternoon of October 12th last to an express passenger train from Blackpool to Leeds. The lay-out of the points in question was peculiar, and the usual detection could not be given, or there would have been no accident. Colonel Woodhouse concludes his report by observing that, having regard to the volume of traffic passing through Preston, the installation of modern equipment seems desirable, and he recommends that this point should not be overlooked when either the signalling or permanent way become due for renewal.

Notes and Memoranda.

IT is said that there are 1700 manufacturing firms in this country which have been in business for 100 years or more.

THERE are now registered in the United States some 25,000,000 motor cars; but, according to the vice-president of the General Motors Corporation, over 6,000,000 of these are in an advanced state of obsolescence.

THE Forest Service of the Canadian Department of the Interior states that the wood of the sugar maple (*Acer saccharum*) is hard, strong, heavy, stiff, and tough, and the heartwood is usually brownish in colour and sapwood a creamy white. The wood planes well and takes a high polish. It wears well, shows moderate shrinkage, and once seasoned properly does not warp or twist to any extent.

WHEN, recently, the first of the three stators for the new plant of the Dunston power station was taken by rail from the Heaton Works of C. A. Parsons and Co., it was several times necessary to move the load from side to side of the trucks during the journey to clear obstructions on the side of the line. This was effected by mounting the girder carrying the stator on rollers, so that it could be moved sideways by means of jacks. The stator weighed 110 tons, was carried by two trucks, and occupied eleven hours on the journey.

A SIMPLE, yet ingenious, system of facilitating the laying of odd lengths of electrical cables has been introduced by the India Rubber, Gutta Percha and Telegraph Works Company, Ltd., of Silvertown. It consists in marking the cable with a distinctive band at every five yards of its length as it is wound on to the drum. As a result it is unnecessary to use a long tape for measuring purposes when unreeling part of the cable from the drum, and the necessity for laying it out on the ground and straightening it out is obviated.

THE conduits used in Philadelphia for the protection of underground electric cables generally consist, according to Mr. H. S. Davis, of that city, of single terra-cotta duct laid up in various formations, and protected on all sides by a 3in. concrete jacket. Single terra-cotta duct is used in preference to multiple ducts, because of (1) the freedom from liability of communication at the joints of faults from cables in one duct to those in another; (2) the convenience in splitting over or under obstructions encountered; and (3) the ability to spread the ducts when entering manholes to permit the cables being spliced together without sharp bends.

EXPERIMENTS on the storage of apples, carried out at the Ditton Laboratory, near Maidstone, show that the best results are obtained with a store kept at a temperature just above freezing and with an atmosphere having an excess of carbon dioxide and a deficiency of oxygen. In practice this means that an ordinary cold storage chamber needs to be made gas-tight, by coating the walls inside with vaseline, and equipped with an instrument for showing the proportion of carbon dioxide in the atmosphere. It is said that in one commercial store the cost of installing the refrigerating and gas plant was earned twice over in one season by the enhanced price of the stored apples.

IN the course of an informal lecture on the production of copper from its ores, to the Junior Institution of Engineers, Mr. Taplin stated that the dominating position of the United States of America in copper production is in the course of passing into the hands of the British Empire. Canada has an exceptionally cheap producer in Noranda, and one of the most remarkable base metal mines on earth in the Frood Mine of International Nickel—copper, nickel, and precious metals—whilst recently immense ore reserves have been proved in Northern Rhodesia, where there were even greater potentialities. Broadly, the U.S.A. ores range from 1½ to 1¾ per cent. copper and the Rhodesian from 3 to 5 per cent.

A NOTE issued by the American Society for Testing Materials says that certain power cable interests have become greatly interested in the examination of lead and lead alloy cable sheaths by means of X-rays. With this in view, and because of the dearth of concise information, there has been prepared a technical report, with comments by several members of Committee E 4, on the subject of Metallographic Methods for the Examination of Lead and Lead Alloys. Since this promises to be of great value to the power cable industry and to all users of lead sheath cable, it is planned to publish, at the time of the next A.S.T.M. annual meeting, a technical paper on the subject. A recommended practice will be included with the present revision of the Recommended Practice for the Examination of Non-ferrous Alloys.

A MATERIAL, to which the name of "Sinterkorund" has been given, is a new ceramic product recently developed by Siemens and Halske. The product is obtained by sintering pure aluminium oxide to a completely opaque crystalline body at about 1800 deg. Cent. The material, according to the *Chemical Trade Journal*, resembles porcelain, but its specific resistance at 400 deg. Cent. is stated to be 100,000 times that of porcelain, whilst at 700 deg. its specific resistance is 100 times that of fused quartz. "Sinterkorund" is expected to find application as an insulating material for sparking plugs, particularly for aero meters, and also as a constructional material for chemical plant, as it is completely resistant to hydrofluoric acid, fused alkalies, &c. Its hardness is 9 on the Mohs scale.

FLOW lines in steel that has been stressed beyond the yield point are brought out by the Fry method of etching, if the steel contains a small amount of nitrogen—between 0·01 and 0·05—but not outside these limits. Bessemer steel usually contains nitrogen within these limits, as does also weld metal, but open-hearth steel is lower in nitrogen and therefore could not be studied by this etching method. It has now been discovered by F. R. Hensel and C. W. MacGregor, of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, that the etching method may be used with open-hearth steel if the steel is nitrided. The best procedure is to cut sections, exposing the faces to be studied, after the material has been overstrained, then give it the nitriding treatment, and finally etch it, which brings out the flow lines and strain patterns.

Miscellanea.

THE output of coal in Russia during last year was practically double that of 1913.

A SHIPYARD for building river tugs is being put up at Dnepropetrovsk. Its cost is estimated at 48 million roubles.

A FACTORY for making piston rings is to be put up at York Township, Toronto, Ontario, by an American firm from St. Louis.

AN aluminium factory is being put up at Kandalaksch, Kolsk Peninsula, Russia. It is to have an output of 40,000 tons a year and will be working next year.

IT is reported that the Dutch Government is inclined to postpone further work on the reclamation of the Zuider Zee on account of the present economic conditions.

AN air-taxi fitted with Marconi telephone equipment, which enables the pilot to keep in touch with the ground, is the latest addition to London's transport facilities.

IT is said that the exhibition of British goods, which is to be opened in Copenhagen next September, will be the largest held in that city since the Scandinavian Exhibition of 1888.

SYDNEY Harbour Bridge was officially handed over to Mr. M. A. Davidson, the New South Wales Secretary of Public Works, by Mr. Ennis, on behalf of the builders, Dorman, Long and Co., on Tuesday, the 15th.

WORK has been started on the new bridge to connect Venice with the mainland. It will be about 2½ miles long by 65ft. wide, with a roadway of 33ft., a tramway of 24ft., and a footway 8ft. wide. The cost is put at £1,370,000.

EXPERIMENTS are being carried out in the Kosogorsk metal works in the Moscow province to obtain spongy iron direct, without preliminary blast-furnace smelting. The first experiments have, it is said, yielded good results.

A GROUP of prospectors working in the Khakassk-Minussinsk region of Siberia has discovered some new copper deposits. The largest of these were at Bazyrsk, where, according to preliminary data, the deposits contain not less than 500,000 tons of ore.

PLANS are being drawn up in Russia for the construction of an energy and industrial centre on the river Sulak, in Daghestan. The plans, says the *British Russian Gazette*, include provision for ten hydro-electric stations, and the chief consumers of the energy thus supplied will be aluminium, magnesium and carborundum works, for all of which the raw materials are close at hand.

ACCORDING to the *Daily Telegraph*, Monsieur Esclangon, the director of the Paris Observatory, has devised a talking clock and several of them are to be installed in the Observatory. The clock will, when called upon, announce the time by the hour, minute, and second to the nearest ten seconds. Any telephone subscriber, on asking for the proper number, will be connected with one of the clocks and will hear the time.

THE Education Committee of the London County Council last week received with great regret the resignation of Mr. John Weir, M.I. Mech. E., F.R.G.S., from the Advisory Sub-committee of the L.C.C. School of Engineering and Navigation. Mr. Weir, who is a partner in the well-known engineering firm of R. and H. Green and Silley Weir and Co., has served on the Advisory Sub-committee since 1915, and has been chairman since 1927.

WHAT is claimed to be one of the largest planing machines ever built in this country has just been completed by Loudon Bros., Ltd., Johnstone. It is intended for machining turbine casings for an extensive hydro-electric scheme in Russia, the planer being arranged to admit work 13ft. wide by 36ft. in length. The total weight of the machine is close on 200 tons. The power of the various motors is as follows:—Driving, 80 H.P.; traversing, 12½ H.P.; pumps for forced lubrication, 1 to 3 H.P.

ACCORDING to Monsieur Fernand Blondel, who has explored the undeveloped Sakoa coalfield in Madagascar, the known deposit extends over a considerable area of 7¼ miles and has an average thickness of 36ft. The existence of a large tonnage of coal is established, and it is estimated the total supplies reach 300 million tons. The coal carries 27 per cent. of volatile matter, 10 per cent. of ash, and 0·5 per cent. of sulphur. The deposit is situated at a distance of about 110 miles from the seaport of Tuléar, in the south-west of the island.

FOR the completion of the "regional" broadcasting scheme for Switzerland, the Swiss Administration of Telegraphs and Telephones has ordered a new Marconi transmitting station to be erected in the Tessin, in Italian Switzerland. The regional transmitters for German Switzerland and French Switzerland are already in operation at Beromunster and Sottens respectively. The new station, which is to be erected on Monte Ceneri, is expected to be in operation by the end of this year. It will have an energy of 15 kilowatts unmodulated power in the aerial.

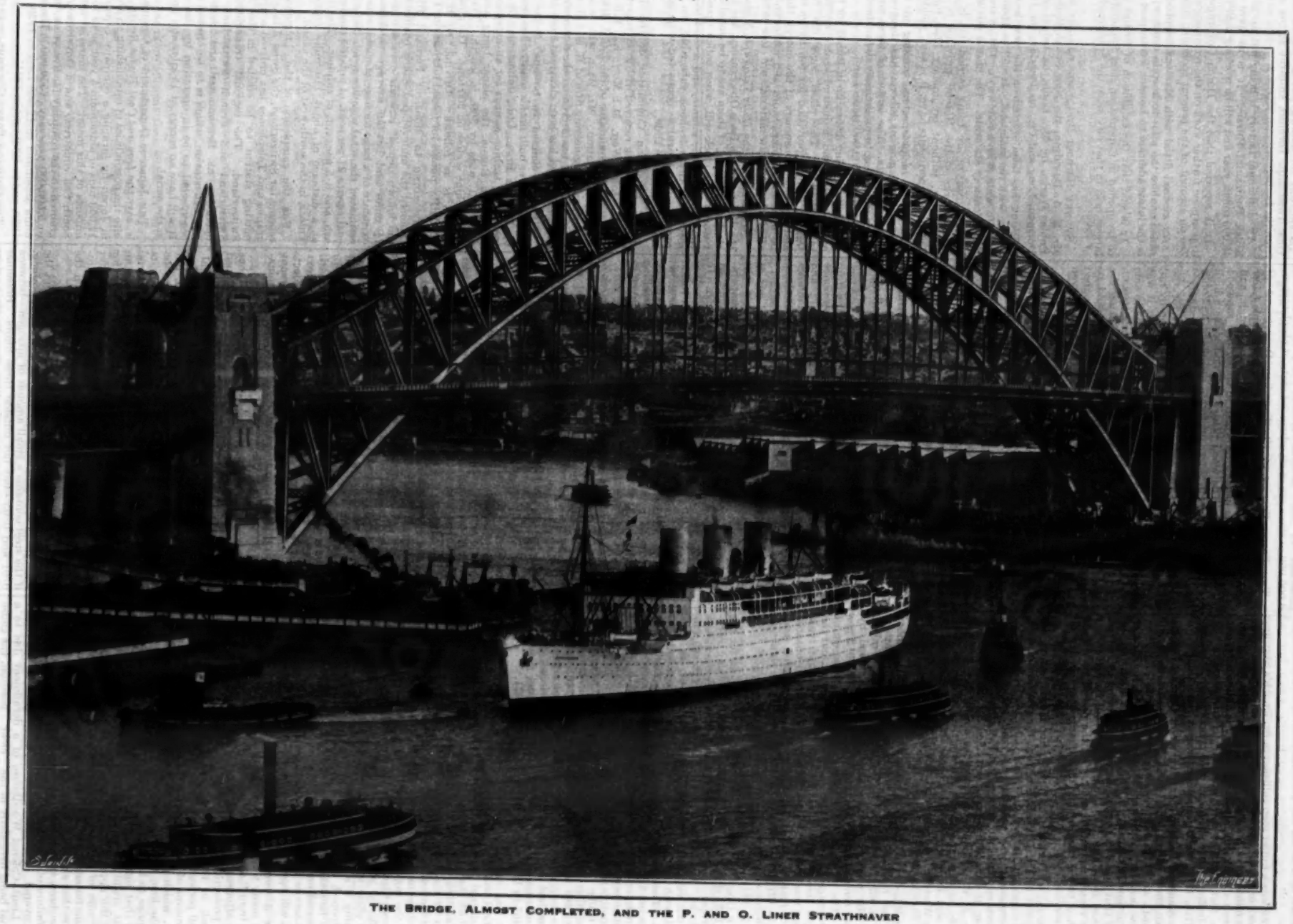
THE Japanese Department of Commerce and Industry is, says the *Iron and Coal Trades Review*, making inquiries into the possibilities of establishing an aluminium industry in Japan by forming a company capable of turning out 12,000 tons of aluminium a year so as to stop entirely the imports of this metal. The material will be got from the South Sea countries, and a Government subsidy will be granted to the company for five years, amounting in total to 5,500,000 yen—say, £550,000. The imports of aluminium amounted to 12,000 tons in 1929, to 11,400 tons in 1930, and to 5000 tons in 1931.

THE Gatineau Power Company, a part of International Hydro-electric System of Canada, has commenced the construction of additional sub-station and transmission line facilities in order to provide for expanding electric power requirements in the Ottawa and Hull districts. The capacity of the company's Val Tetreau sub-station for supplying 11,000-volt power is being increased from 40,000 horse-power to 80,000 horse-power through the installation of three additional 10,000-kVA transformers of the outdoor switching type, and additional 110,000 and 11,000-volt switching equipment.

SYDNEY HARBOUR BRIDGE

DORMAN, LONG AND CO., LTD., MIDDLESBROUGH, CONTRACTORS

(*For description see page* 304)



THE BRIDGE, ALMOST COMPLETED, AND THE P. AND O. LINER STRATHNAVER

The Engineer

MARCH 18, 1932.

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TWO-PAGE SUPPLEMENT—SYDNEY HARBOUR BRIDGE.

DEATH.

ON February 23rd, at Malahide, Co. Dublin, Mr. W. F. HALDANE, late Manager of the Irish offices of the British Thomson-Houston Company, Ltd.

NOTICES TO READERS.

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

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**** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

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MODERN SWITCHGEAR.

WITH the great increase in the capacity of power stations and the introduction of the "grid," switchgear problems have become much more difficult than they were in bygone days. Switchgear associated with large power schemes is massive and expensive, and many an engineer would welcome new and less costly apparatus for opening and closing circuits under heavy current conditions. For more than thirty years the oil circuit breaker has been used as an interrupter for A.C., and is still regarded by many as the most practical and effective device so far developed for the purpose, although, as shown in Mr. H. W. Clothier's recent I.E.E. paper on "Metal-clad Switchgear Developments during the Past Seven Years," other devices have been evolved. On these new circuit-breaking schemes much has been published. Many patents relating to them have been recorded in the columns of THE ENGINEER. There are now gas or air-blast breakers, de-ion air breakers, de-ion grid oil breakers, oil blast breakers and water or expansion breakers. But only service over an adequate period can determine the proper place of each in the electricity supply industry. The new switches are not, of course, universally regarded as a boon, or as a credit to their originators, who have had the courage to break away from orthodox practice. Few new schemes fail to meet with opposition, especially if they are covered by patents or tend to interfere with existing manufacturing arrangements. Manufacturers who have built up a good business by making a particular type of apparatus are not always keen on producing something with which they are unfamiliar and have little sympathy. The power rectifier did not escape criticism from rotary converter builders, nor did the turbine steer clear of opposition from the reciprocating engine people. But for the very simple reason that no British manufacturer has hastened to market the new circuit-breaking devices before his competitors, there has been no battle between switchgear firms. The user is always the most interesting and, generally speaking, the most genuine critic, but even in America and on the Continent he has not had a very long experience with this apparatus.

If any general conclusion can be drawn from published information that has come to our notice, it is perhaps that the oilless switching is not very suitable for extra high voltages. Writing in the *Journal* of the A.I.E.E. of April, 1931, Mr. J. B. MacNeill says: "While all these devices possess good arc rupturing capacities, they are subject to the limitations of available insulating materials. Their application to high voltage systems makes difficult the problem of co-ordinating the impulse values of lines and apparatus. For reasons of insulation and difficulty of operation in unfavourable locations, conservative engineering would seem to limit the use of the non-oil-filled circuit breakers to voltages of 25 kV and below, and for the most part to indoor service. Improvements have been made in oil circuit breaker design, which assist system stability, reduce arc energy, contact wear and breaker maintenance. To secure co-ordination of apparatus and line insulation on large systems, the growing requirements for ample insulation factors on high-voltage circuit breakers, after as well as before rupturing duty has been performed, makes the use of oil in circuit breaker interrupters extremely desirable for ratings above 25 kV, especially in the case of outdoor service." Mr. L. C. Grant, in discussing Messrs. F. B. Wedmore, W. B. Whitney and C. E. R. Bruce's paper on "An Introduction to Researches on Circuit Breaking," read before the I.E.E. in 1929, gave some startling examples of what can happen in the absence of oil, even at a pressure as low as 6 kV. With all its disadvantages, and notably the fire risk, engineers will probably require a lot of convincing that oil can be dispensed with in heavy-duty circuit breakers working at extra high voltages. It is, however, far from our desire to discourage the development of oilless breakers. Some of them have been designed for 100 kV, but one Continental firm that produced such breakers is said to have since withdrawn them from the market. But the British Electrical and Allied Industries Research Association, which has been working on circuit breaking problems for something like ten years, does not deem these breakers to be impracticable. Bearing in mind the vast changes that have been made in power supply practice within the course of a few years, it is scarcely safe to say that anything is beyond the range of possibility. Great as the improvements have been, the state of finality has not been reached, or, possibly, even approached. The new switches are only casually mentioned in Mr. Clothier's paper, which mainly discusses modern metal-clad gear involving the use of oil. No one has contributed more to the I.E.E. "Proceedings" on this important subject than Mr. Clothier, whose experience goes back to the days when circuit breaking was a relatively simple business. But his paper is confined to progress during the last seven years, which has brought a change in national policy. Divided into four main sections and containing four appendices, it discusses practically all points in connection with modern metal-clad gear, besides covering such matters as the automatic isolation of faults and remote and automatic control.

Of all the matters that claim the careful attention of switchgear manufacturers in these days, none are more important than that of ensuring that the gear will stand up to its job. In other words, the testing of switchgear under conditions approximating to those likely to be met with in practice. How important and costly this business is if carried out thoroughly can be gauged from the fact that one firm is at present in the middle of a six months' testing programme, the cost of which will represent 80 per cent. of the cost of production of the breakers made during that period. Such testing programmes need not, of course, be continuous, but even if they are only undertaken periodically, they may represent a charge on the production cost in the neighbourhood of 20 per cent. It is an easy matter to give a breaker a rating, but purchasers of switchgear in these days would be well advised to ensure that it has been based on actual test records. A proving house for rupturing and circuit-making tests is required to enable the products of different manufacturers to be certified. The cheap breaker with an arbitrary rating may appeal to engineers anxious to reduce installation costs, and, with luck, may serve the purpose; but, on the other hand, a bad fault may lead to its total destruction, damage to property, and even loss of life.

Vehicles and Air Resistance.

LIKE the denizens of the sea bed, we humans, too, have to live at the bottom of an ocean of fluid; but, unlike them, we are barely conscious of its presence, since its surface is beyond our reach. Whilst it is nearly 300 years since Torricelli weighed the atmosphere, not until comparatively recent years has the fact that it existed influenced human affairs. The chemist no doubt found its composition intensely interesting and not unuseful for experimental purposes. The engineer used it—as a chemical—to combine with carbon and so produce heat and motive power. Physicists found that it was compressible and expansible according to certain laws. But, excepting the scientists and the ballistician, no one bothered his head about the fact that he lived at the bottom of a sea of air. Really it was the advent of the internal combustion engine, and particularly of that form of it which utilises petrol as a fuel, that brought home to the average man his relationship to the atmosphere. The new prime mover had a revolutionary effect upon transport. Developing power, as it did, with a horse-power-weight ratio very much smaller than that of the steam engine, it made the high-speed aeroplane and motor vehicle possible and brought man into dynamic instead of static contact with the air, and made him conscious of the speed limit imposed by the atmosphere.

When a traveller journeyed from place to place on the top of a stage coach he was, in winter, unpleasantly conscious of the breeze created by the movement of the vehicle through the air. But his only thoughts were to draw the muffler more closely round his neck and promise himself a larger glass of mulled ale at the next halting place. The coming of the railway gave him a closed coach in which to travel, and unless he chose, at the risk of getting a cinder in his eye, to put his head out of the window, there was no reason why he should discern the force with which the air was resisting the train. Even when railway speeds increased the efforts of locomotive designers to reduce head resistance by coning smoke-box doors were lightly regarded, and attempts to reduce the side resistance of trains were not encouraged. The first sign that the influence of the air was beginning to be felt is provided by the design of the airship. The balloon shape, admirably adapted for a drifting aerostat, was soon discarded for that of the cigar, since by giving the envelope such a form the useful lift could be increased without at the same time realising a corresponding increase in the resistance to motion. But since the airship was not at once found to be very successful, this first lesson on the importance of streamlining was not taken greatly to heart. It was not until the aeroplane began to develop speeds in excess of 100 miles an hour that man began to realise how important was the resistance offered by the atmosphere to the motion of bodies through it. A study of the subject was begun and some extraordinary results became apparent. The small diameter stay wire, it was found, could be profitably replaced by a wooden or metal strut with a maximum cross-sectional width several times greater so long as that strut was shaped in a special way, which had been indicated by the illuminating method devised by Dr. Hele Shaw. The matter was taken still further by international competition for the highest speeds on land, sea, and water. In order to obtain the velocities necessary to win the races for the Schneider Trophy the machines entered for the competition had to be streamlined to an extraordinary degree. Similarly, when the land speed record began to approach 200 miles an hour the streamline design of the car began to assume a very great importance. It is instructive to examine the design of the series of cars that have attacked that record. The series begins with cars designed with little thought of the effect of air resistance upon them, and ends with such marvels of streamlining as the late Sir Henry Segrave's "Golden Arrow" and Sir Malcolm Campbell's "Blue Bird," in both of which a compromise is made in every part between the necessities of the mechanical design and the importance of reducing the air resistance to the lowest possible proportions. To-day every country of the world is fully alive to the possibilities of streamlining vehicles against air resistance, but on railways, despite the efforts of Mr. Dendy Marshall, it has made little progress. Last autumn a paper on the subject by Messrs. Tietjens and Ripley was read in America. It described some of the results obtained by

researches upon the effect of streamlining trains and motor cars, and the figures at which the authors arrived are very striking. From a graph given in the paper comparing an ordinary train drawn by an electric locomotive with a similar train streamlined, we find that 25 per cent. less power is required to draw the streamlined train at 60 miles per hour. Nowadays locomotives are constructed to haul trains at speeds exceeding 80 miles per hour. Exactly the same train, streamlined, according to the authors' figures, would be capable of travelling at 110 miles per hour. Such a speed is comparable with that of the aeroplane. The train is already, owing to its snake-like form, partially streamlined. That fact explains why the saving attendant upon streamlining a motor car is much greater. To attain a speed of 80 miles per hour the modern saloon car must be fitted with an 80 H.P. engine. The same engine installed in a streamlined body could propel the vehicle at 150 miles an hour. Even if great straight inter-urban highways were constructed, it is a matter of some doubt whether such a speed would be considered desirable. At present, certainly, 80 miles per hour is deemed fast enough, but as man's attitude to speed has developed with his ability to increase it, we know not what velocity may be regarded as moderate some years hence. With streamlined design only 35 H.P. instead of 80 would be required to attain this speed, and a vehicle that at present does about 12 miles to the gallon would have its range more than doubled for the same fuel tank capacity.

These results, it must be stated, were obtained by the American experimenters by suspending small-scale models in a wind tunnel. Before the results can be taken as a true indication of the possible savings to be made by streamlining full-size vehicles, many factors must be considered. Nevertheless, the results are sufficiently striking to suggest that experiment on the full-scale is desirable and that it might lead to valuable discoveries. Already a fully streamlined motor car has been produced, while in Germany a few experiments have been made with a streamlined rail car, and streamlining is employed in Mr. Bennie's ingenious rail-plane. Even in the design of motor cars that partake not at all of the "freak" nature there seems to be a tentative movement towards taking into account the importance of air resistance. Are we at fault in believing that we discern some faint family resemblance between Segrave's "Golden Arrow" and many of the low-built small sports cars to be seen on the roads to-day?

Institution of Naval Architects.

No. I.

THE annual general meeting of the Institution of Naval Architects was held at the Royal Society of Arts, John-street, Adelphi, London, on Wednesday, Thursday, and Friday, March 16th, 17th, and 18th. Admiral of the Fleet the Right Hon. Lord Wester Wemyss, President, opened the meeting on Wednesday morning, March 16th, when there was a large attendance.

The first business was the presentation of the annual report of the Council for 1931, from which some paragraphs are reprinted below.

The losses through death and resignation during the past year have been exceptionally severe, and the continued depression in the shipbuilding industry has naturally had its adverse effect upon the membership position. Members are invited to put forward candidates to fill the vacancies which have been created, but the financial situation of the Institution has been satisfactorily maintained, notwithstanding trade depression and increase of taxation.

The summer meeting held in France last July proved an unqualified success. The meetings were opened in Paris by the French Minister of Marine, and the papers contributed by our members and those of the Association Technique Maritime et Aéronautique were of a high standard of excellence and interest. Receptions in honour of the meeting were given by the Ministry of Marine, the Military Governor of Paris, the authorities of the International Colonial Exhibition at Vincennes, the Paris Chamber of Commerce, and the Bureau Veritas. The honorary membership of the Institution was conferred upon Monsieur E. Rousseau, President of the Association Technique Maritime et Aéronautique. A picture of H.M.S. "Lion" in action, painted by Mr. Harold Wyllie, was subsequently presented to the Association Technique Maritime *et* Aéronautique as a souvenir of the meetings.

The Council has elected as Honorary Vice-President Engineer Vice-Admiral Sir George G. Goodwin, K.C.B., LL.D., in recognition of his long and valuable services on the Council.

William Froude Laboratory.—The volume of work carried out in the Yarrow Tank during 1931 was somewhat less than in previous years, but since the close of the year the number of inquiries has shown signs of increase. The construction of the second Tank, the cost of which has been defrayed by the Government grant, has been proceeding rapidly, and the Tank is expected to be ready for operation in the course of next summer. The research fund has now reached a very unsatisfactory position, as the surplus which existed some years ago has been drawn upon to make good the annual deficit, and is now exhausted. Consequently, the amount available for research is very greatly reduced, and the research is entirely dependent on contributions received from shipbuilding firms, and the Chamber of Shipping, supplemented by the Government grant of pound for pound on all sums so contributed.

The Secretary, in presenting the report, mentioned that the entries this year for the National Certificates in Naval Architecture are considerably larger than in previous years, an indication of a much greater interest being taken in the National Certificate.

Mr. Francis Henderson, Hon. Treasurer, presenting the accounts for 1931, pointed out that, although the receipts were considerably less than in the previous year, it had been possible, by means of economies, to show a small balance on the right side. He added that some question had arisen with the Income Tax authorities as to payment of income tax by the Institution. Hitherto, he said, the Institution had regarded itself as a scientific institution, and as such it had been exempt from income tax. The Commissioners, however, last year, probably owing to the hard times, seemed to have changed their opinions on this matter with regard to the Institution and other institutions and had demanded payment of income tax on dividends, not only for last year, but for previous years. Naturally, this went very much against the grain and three members of the Council saw the authorities, whilst at the same time Mr. Dana, the Secretary, prepared a memorandum on the subject, which was laid before the Commissioners. The result, fortunately, was that the Commissioners decided that the Institution was right in its contention and therefore it would remain exempt from payment of this income tax.

The following elections were then announced :—

President.—Admiral of the Fleet the Right Hon. Lord Wester Wemyss, G.C.B., C.M.G., M.V.O.

Vice-Presidents.—J. Foster King, C.B.E., Sir Thomas Bell, K.B.E., Sir Eustace T. d'Eyncourt, Bart., F.R.S., Sir Westcott S. Abell, K.B.E., The Right Hon. Lord Weir, P.C., LL.D., Sir William J. Berry, K.C.B., James Brown, C.B.E., Summers Hunter, C.B.E., Engineer Vice-Admiral Sir Robert B. Dixon, K.C.B., Professor P. A. Hillhouse, Sir John Thornycroft, K.B.E., H. Ruck-Keene, Professor J. J. Welch, A. W. Johns, C.B.E., R. J. Walker, C.B.E.

Hon. Treasurer.—Francis Henderson.

The Premium for the past year, awarded to Mr. L. C. Burrill, B.Sc., for his paper on "The Seaworthiness of Collier Types," was presented to him by the President.

The President then delivered his presidential address as follows :—

PRESIDENTIAL ADDRESS.

The past year has, as we know all too well, been a doleful one for those engaged in the science and art of shipbuilding. Our Institution is fortunate in that, although it is composed of members whose principal interest is the building of ships, yet, being a non-commercial body, it does not suffer to the same extent from the fluctuations of trade and industry. The total number of our members has only dropped by 110 below the maximum number in 1923, and this reduction is entirely due to the falling off in the number of students, while all other classes of membership show an increase over the figures of nine years ago. Young men, not unnaturally, are more attracted at present by other occupations, as they regard the prospects for shipbuilding with evident distrust. Yet we have hopes that there will soon come a turning in the long lane of our declining industry, and that with the revival of trade which the new conditions foreshadow there will spring up a renewed demand, firstly for shipping and then for new tonnage to replace obsolete and obsolescent types. Shipowners have in the past been ready to place orders for new ships in anticipation of trade revival, and we must hope that history will repeat itself in this respect. In other respects the Institution is maintaining its good traditions, and supplying the technical world with the results of valuable experience, investigation, and research, collected from many sources, at home and abroad, and discussed with critical acumen by the leading experts of our own and other countries.

Our summer meetings, which have, especially of late years, been a feature of the Institution's proceedings, culminated in the one held in France last July. Nothing could exceed the genuine kindness and hospitality with which we were received and fêted, both in Paris and along the banks of the Loire. No international gathering could be marked with greater cordiality or better mutual understanding. Politicians and newspapers may sometimes have acrimonious discussions due to inherent prejudices and lack of tolerance—sometimes also due to genuine misunderstandings or conclusions based on false premises, but in our technical discussions there was nothing to mar the serenity of the proceedings, and I feel sure that much good has resulted from the free interchange of opinion which took place upon those questions which were so ably debated by the naval architects of both countries in the Hall of the Salle d'Iena in Paris. I would like especially to express once again our high appreciation of the way in which the French Government, represented by the Ministre de la Marine, honoured us by his presence at our opening meeting, and by the splendid evening reception given in the beautiful rooms of the French Admiralty.

To the President, Council, Secretary and Members of the Association Technique Maritime et Aéronautique our heartiest thanks are due for organising this joint meeting of our two societies, which must always be remembered as one of the very best of its kind we have ever held.

The Institution has this year lost one of its oldest and most respected members, Sir Alfred Yarrow, who had during a long and strenuous life helped not only to build up a great and flourishing industry, but had shown himself a whole-hearted and public-spirited benefactor in many different fields of philanthropic enterprise. He had given largely, not only to institutions destined to promote and improve human health and happiness, but also to scientific and industrial research, to enable greater progress to be made in the shipbuilding work which he had helped to create and by which his own fortunes had prospered. It is to Sir Alfred Yarrow's generosity that we owe the experiment tank at the National Physical Laboratory, where for over twenty years most valuable work has been carried on, both for private firms and for general purposes. Every year we appeal for support from the shipping and shipbuilding industries to the Research Fund, which has to defray the cost of all work not paid for by private firms for experiments based on their own designs. The response received this year, so far, has been disappointingly small, but it is, we know, a most difficult time for appealing for funds from companies whose dividends for the last few years have had to be cut down or passed altogether. Yet the fact remains that the progress of shipbuilding depends more than ever, in these days of severe competition, on following up lines of improvement which are indicated by scientific research. The staff at the William Froude Laboratory—as the experimental tank is now called—under the able direction of Mr. G. S. Baker, the superintendent, has for many years carried out a most valuable methodical series of model experiments from which builders can derive reliable information, upon which to base estimates and designs for new work, as orders or inquiries are received. No one who has any practical knowledge of the working of the tank at the National Physical Laboratory can doubt that the research work accomplished there, much of which has been published in our "Transactions," has been of the utmost value to our shipping and shipbuilding industries. Notwithstanding the lean years we are now experiencing, I would therefore earnestly call upon the shipbuilding and marine engineering firms to contribute as generously as possible this year to enable the research work to be maintained. Sir James Lithgow has recently made an important contribution of £5000 for the equipment of apparatus for propeller research, but neither this nor the Government contribution last year of some £40,000 for the construction of a new tank, will assist the Research Fund at all; in fact, these benefactions will, if anything, throw an additional burden upon that Fund by giving more material facilities for research work to be carried out, leaving the problem of salaries and wages still to be solved.

Other countries have, as we know, made great strides in ship model research work, and we find more liberal support being given to carry on research work in the experiment tanks of America, Germany, and Italy. We were the pioneers in this form of ship research, and it is common knowledge that the system and methods initiated and developed by William and R. E. Froude have stood the test of time, and have been recognised throughout the maritime world as valuable aids to scientic shipbuilding. It is therefore all the more important for us to retain the advantage of having been first in the field, and not to lose, for lack of support, our high reputation for this special work which has been built up by a long line of successful investigators.

I make no apology for dwelling at some length upon this topic, as I believe it to be a matter of great importance to our prestige and position in the shipbuilding world.

Shipping and shipbuilding are indissolubly connected, and a maritime nation such as Great Britain is dependent for its existence on its shipping being maintained in a strong and healthy condition.

The late world war brought home to other nations the value that accrued from building and owning their own ships, with the result that, whereas Britain formerly owned 58 per cent. of the world's tonnage, at the end of 1931 it only owned half of this, namely, 29 per cent., or 20,300,000 out of a total world tonnage of 70,100,000. At the close of 1931 only 400,000 tons were under construction in this country. It is to be hoped that the very lowest depths of depression have now been reached, and that ere long world confidence will be born again and trade improve.

The percentage of unemployment is more extreme in the shipbuilding industry than in any other trade, viz., 60 per cent., and it must not be forgotten that shipbuilding is a skilled trade, requiring a continuous supply of new entrants into it. Situated as it is at present, it can neither train its apprentices in the only way in which they can be trained, namely, by practical experience, nor does it offer attractive inducements to new entrants. The plight of the industry cannot be regarded with apathy, and the attitude taken by the Government in connection with the suspended construction of the new Cunarder is greatly to be regretted.

Discrimination is surely essential, even when pursuing the path of ruthless economy, and in view of international competition, I do think that no better advertisement could have been given to the world of Britain's continued confidence in itself, and of its supremacy in shipbuilding and engineering, than by assisting the completion of this great vessel. In the event of this Cunarder not being launched this year, then in 1934 the supremacy of the Atlantic will be

left to be competed for by the latest productions of our Continental rivals, and we shall not even come into the picture.

I hesitate to make any criticisms of the political situation, but a few words on the remarkable change in national sentiment since April 1930, may not be out of place, as this change has undoubtedly affected very profoundly our industrial and economic outlook, including, of course, shipbuilding and marine engineering. In the political world the past year has been memorable for an election, the like of which none of the present generation can remember. The country had grown profoundly dissatisfied with the economic and industrial situation, and was completely disillusioned as to the beneficial results of socialistic legislation. But no one, or at least very few, even of those in close touch with the inner wheels of the political machine had ventured to foresee or foretell the tremendous change over which was to take place last autumn. It has shown, I think, what many of us have believed in through days of doubt and anxiety, namely, the fundamental common sense and political honesty of the British working man and woman voter. Roused to a sense of the country's peril by the plain blunt words of the late Chancellor of the Exchequer, and of the leaders of other parties, voters realised at last that the national finances could only be balanced by heavy sacrifices on the part of employers and employed alike, and also on the part of the staffs of Government Departments which had greatly increased since pre-war days. Once this situation was faced and accepted, the inevitable steps to carry this policy into effect were taken without either undue haste or undue delay. The decision to go off the gold standard was part of the general measures taken, although that step was brought about through other causes.

The momentous decision to embark on a policy of tariffs was one which had been gradually forcing itself upon the minds of all thoughtful persons, and even some of the most hard-bitten and uncompromising Free Traders had at last come to realise that a trial must be given to some measure of protection that would prevent vital industries from leaving our shores and stop our foreign competitors from dumping their surplus goods upon our open markets. That such drastic changes in our political orientation could not be lightly undertaken, or the details settled without most careful consideration was evident, and the National Government has set about its difficult task in a spirit of fair-mindedness and moderation, taking only such steps as will be effective without going beyond the real necessities of the present time. Already these measures have borne fruit, as we have found a disposition on the part of some of our friends abroad to meet in a more conciliatory spirit such representations as we have had to make regarding the incidence of foreign tariffs on our own export trade.

The other significant policy which our National Government has embarked upon is that of close relations with the Dominions Overseas. Nothing could be more desirable than to promote better and closer relations with those great bodies of our own countrymen, who, through their enterprise and courage, have built up these Daughter States of the Mother Country. We know how, in the eighteenth century, ignorance and indifference on the part of the home Government created disaffection in the minds of our North American colonists, and how this led eventually to secession, active rebellion and a final liberation from the thraldom of a tyrannical Government. To-day we are witnessing the effect of an opposite policy, and we see the bonds that unite us to our countrymen overseas strengthened by the tolerance and respect in which their views, their desires and aspirations, are received by our Government. Their dependence on this country is offset by our dependence on them for material aid in time of peril, and for that future expansion to which our ever-growing population must look for its ultimate development. The aid which the Dominions gave us in the Great War, when their sons left those distant shores and laid down their lives for the Mother Country, is one of those generous impulses the memory of which can never grow dim. Can we, to-day, forget that what has happened before may once again force upon us the need to protect not only our shores but our trade routes? It is this thought which forces upon us the ever-growing conviction that the reduction in our naval strength since the war has now gone far enough. It is true that our treaty obligations have tied our hands, but we have, in some directions, gone beyond those obligations, and have, in our endeavour to effect economies, reduced our naval strength below the safety limit. We have no desire to display aggressive tendencies, but we must protect against the unilateral character of recent disarmament measures. The lead given by this country in voluntarily relinquishing part of our naval superiority in the hope that others would follow suit has failed to evoke adequate response. While we have decreased our naval expenditure by £8,000,000 between 1925 and 1930, the world expenditure in armaments during that period has increased by no less than £126,000,000. For our island country there is no alternative; the Navy must be maintained or our security vanishes. Our 80,000 miles of sea routes must be protected; yet our cruiser strength has fallen to less than one-half of what it was in 1914, and of the existing vessels many are obsolescent. Since the war we have only built seventeen cruisers, and in the last four years only five, instead of the twelve which are considered to be the bare minimum required. No warship has been laid down in the year just closed, and even for those which have been authorised the laying down has been postponed. Fortunately, the National Government is alive to the seriousness of our position at sea, and the First Lord has made it plain that we shall, if the Disarmament Conference does not effect its object, have to make good some of the shortcomings of recent years. At a time when our shipbuilding yards are denuded of orders for mercantile ships, it would be a pleasant relief to have some ships to bring into being which, up till now, have perhaps been occupying the thoughts of our naval constructors without, however, getting beyond the design stage.

In conclusion, would you allow me to draw your attention to the Benevolent Fund of the Institution? This Fund was instituted nine years ago, and while the demands made upon it so far have not been very large, there is no doubt that, as time goes on, there will be more opportunities of extending help to those who, through no fault of their own, have fallen on evil times. In these days of acute depression some of those who were once well-to-do may at their death leave little or nothing for their family, and there are sad cases of want among the relatives of those who have passed away and left their dependents in reduced circumstances. The Fund, as you know, is intended to "assist Members, Associate Members, and Associates of the Institution, past and present, or their dependents, who may be in necessitous circumstances." We should like to see a larger number of members become regular subscribers to this Fund, as it is hoped to build up a substantial invested reserve to enable the usefulness of the Fund to expand as the years roll by. Some members may desire to help this Fund by bequest, and I need not say that the Committee of Management would welcome any windfall of this nature which may come under their control, especially if it is free from the exactions of the Revenue Authorities! The good that you may do to your fellow-members will thus live after you, and the seed thus sown may one day yield a rich harvest.

The reading and discussion of papers was then proceeded with.

ANNUAL DINNER.

The annual dinner of the Institution, which was held at the Connaught Rooms on the evening of Wednesday last, March 16th, was a most successful event, and between five and six hundred members and guests attended. The chair was taken by the President, Admiral of the Fleet Lord Wester Wemyss. After the loyal toasts had been duly honoured, the toast of "The Royal Navy" was vigorously proposed by Lord Lloyd, the President of the Navy League, who made a strong plea for less apathy and more interest in our Navy and its work. A sympathetic reply was made by Admiral Sir Cyril T. M. Fuller, the Second Sea Lord and Chief of the Naval *Personnel*, who described what was now being done for the officers and men of our fighting services. The toast of "The Mercantile Marine and Overseas Dominions" was proposed by Lord Stonehaven, formerly Governor-General of the Commonwealth of Australia, and replies were made by Mr. R. S. Dalgleish, the President of the Chamber of Shipping, and Sir Henry Barwell, the Agent-General for South Australia. All three speeches referred to the forthcoming Economic Conference at Ottawa, and emphasised the value to our shipping and trade of a closer understanding between the Mother Country and the British Dominions. The toast of "The President" was fittingly proposed by Mr. Francis Henderson, the hon. treasurer of the Institution, who twenty-one years ago was elected a Vice-president of the Institution. He paid a warm tribute to the work done by the Past-presidents of the Institution, and alluded to the honour and esteem which the present President, Lord Wester Wemyss, enjoys both at home and abroad. In his reply the President emphasised the value of the technical and scientific work of the Institution and its application to international sea transport, and thus closed a very enjoyable evening.

Literature.

Water Diviners and their Methods. By HENRI MAGER, translated by A. H. BELL. London: G. Bell and Sons, Ltd. 16s.

AT the end of the introduction to this book the author writes "My object has been attained. I have solved the enigma of the divining rod, and, perhaps, the enigma of matter." Encouraged by so confident a beginning, we hastened to read the book which was, "perhaps," to explain to us this enigma of matter that has so far defeated the greatest scientists and the greatest philosophers.

Divining is an unsatisfactory study; at least, to those with a scientific sense of values. It has the same relation to true science that has spiritualism. Both these arts appear to fly straight in the face of natural laws. One can believe in levitation or not as one likes, but it is impossible to provide a satisfactory scientific explanation of its occurrence. One can believe or not that a pendulum will describe a circle either in the clockwise or anti-clockwise direction, according to the substance that lies beneath it; but to find a natural law to explain these phenomena is quite another matter. Henri Mager calls upon atomic vibrations and fields of force and influence. Other writers on the subject have made the same attempt to give a scientific explanation of divining. Atomic vibrations, however, are as convenient in this connection as are spirit manifestations for explaining levitation.

We could readily agree that some hitherto undetected law of nature might allow a man by the use of special instruments—or conceivably without an instrument at all—to detect the presence of flowing water or other materials in cavities below ground were it not for the fact that no unanimity exists even among diviners themselves as to the results of the presumed undetected law. If such a law exists, its effect upon all diviners should be the same. What, then, are we to make of the statements of the many dowsers quoted by Monsieur Mager? Some are apparently ready to use anything that comes to hand as a pendulum; a watch and chain, for instance, or a lump of bread on the end of a piece of string. Others, however, find it necessary to use phials filled or partially filled with water, stoppered or unstoppered, the material of which the stopper is made frequently being most important. The effect of passing over water, is different for different people. This man, for instance is so affected by it that its pressure causes him to suffer something analogous to a fit. Muscular contraction causes another to stamp his foot in its presence. Nor, when instruments are used, are they all the same. This diviner must use a hazel switch of special form, while another can use a twisted tape of steel, and yet another whalebone; some find a pendulum supported in the fingers of the hand sufficient, while others must support it at the centre of a little rod, itself held in both hands. What is a scientist to make of such an art?

Henri Mager would have us believe in something between an electrical disturbance and atomic vibrations. But a current that passes up one side of the body to the divining rod and down the other side to earth is difficult to comprehend. A young student might ask what would happen if the two currents became mixed on the way? Such currents must exist, however. How else can it be explained that when new shoes or rubber gloves are worn no influence can be felt? Many diviners find that such wearing apparel deprives them of their powers; others, however, make no mention—in this book, at any rate—of such matters, regarding them, perhaps, as elementary facts not worth quoting. Other diviners are still more sensitive to their surroundings. In the case of the Abbé Lombard, for instance, certain materials, such as silk stockings and fatty substances, interposed between him and subterranean water, cut off the action. How are we to take this statement? The Abbé Bouly was extraordinarily sensitive. He required no rod. In a lecture he stated: "I no longer require a rod, I can see the stream with my eyes; I attune my mind; I am looking for lead, I fix my eyes; I feel a wavy sensation like hot air over a radiator; I see it." An unpleasant sensation, one imagines! We agree with the "Grand Journal du Nord," which is quoted in the book as describing the radio-æsthetic science of the Abbé as a "stupefying science"!

The inclusion in the book of a chapter—a very short one—upon geophysical methods of surveying will not, we hope, deceive any reader into believing that there is any connection, scientific or otherwise, between the electrical method devised by Daft and Williams, the spontaneous polarisation method of Schlumberger, or the magnetic method, and the hazel rod and pendulum of the diviner. The geophysical methods rest upon sound and proven scientific facts, while the movements of the diviner's rod and pendulum have never been scientifically explained, although, if we are to trust Monsieur Mager, they are just as trustworthy. The inclusion of the chapter gives a spurious scientific authenticity to a subject which has more in common with spiritualism than with science.

Henri Mager, we understand, is one of the greatest authorities upon the subject of divining. Starting his investigations several years earlier, he delivered his first lecture on the subject in 1910. Since then he has gone from strength to strength. This book is translated from the fourth edition. Monsieur Mager believes that "perhaps" he has solved the enigma of matter. Perhaps he may convince others that he has done so; he has failed to convince us.

BOOKS RECEIVED.

Mining Year Book, 1932. By W. E. Skinner. London: Walter E. Skinner, 15, Dowgate-hill, E.C. 4. Price 20s. net.

Applied Gyrodynamics. By G. S. Ferry. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

Chemistry at the Centenary (1931) *Meeting of the British Association for the Advancement of Science.* A full report of the meetings in September, 1931. Cambridge: W. Heffer and Sons, Ltd., 104, Hills-road. Price 7s. 6d. net.

EXHIBITS AT THE LEIPZIG TECHNICAL FAIR

(For description see opposite page.)

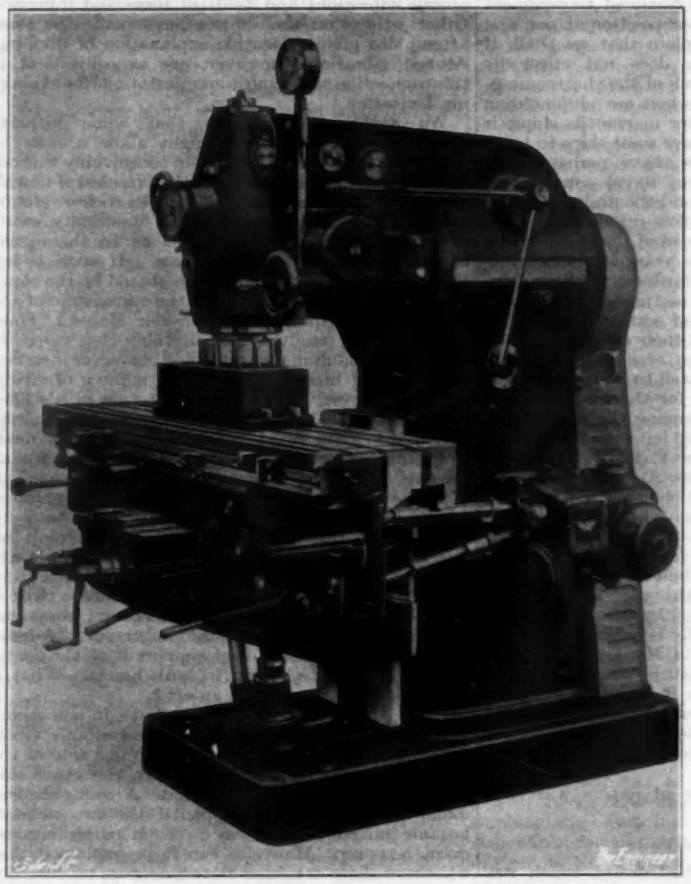


FIG. 15—MILLING MACHINE WITH HYDRAULIC SPINDLE DRIVE—WANDERER

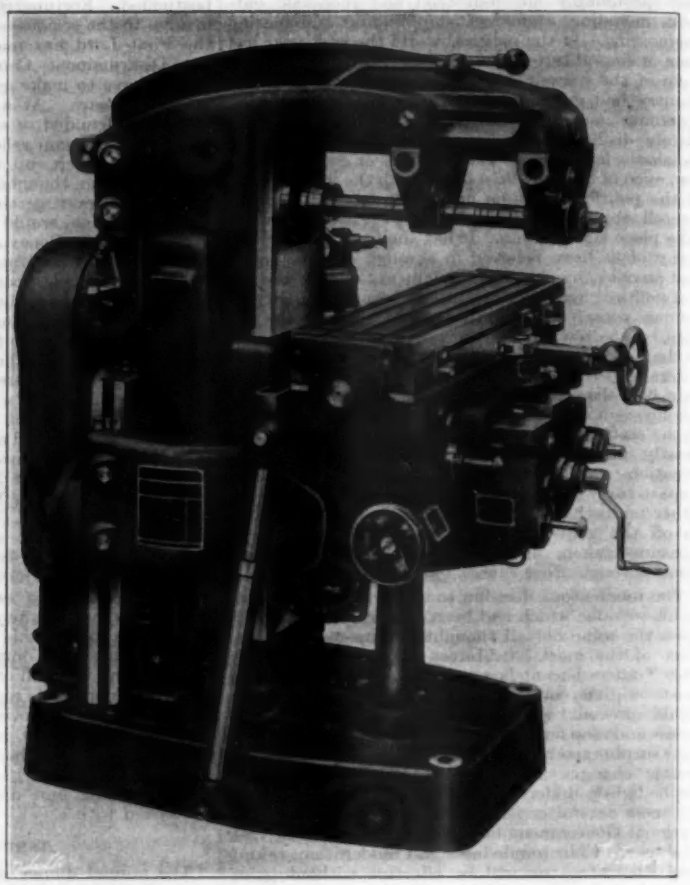


FIG. 16—HORIZONTAL MILLING MACHINE—WANDERER

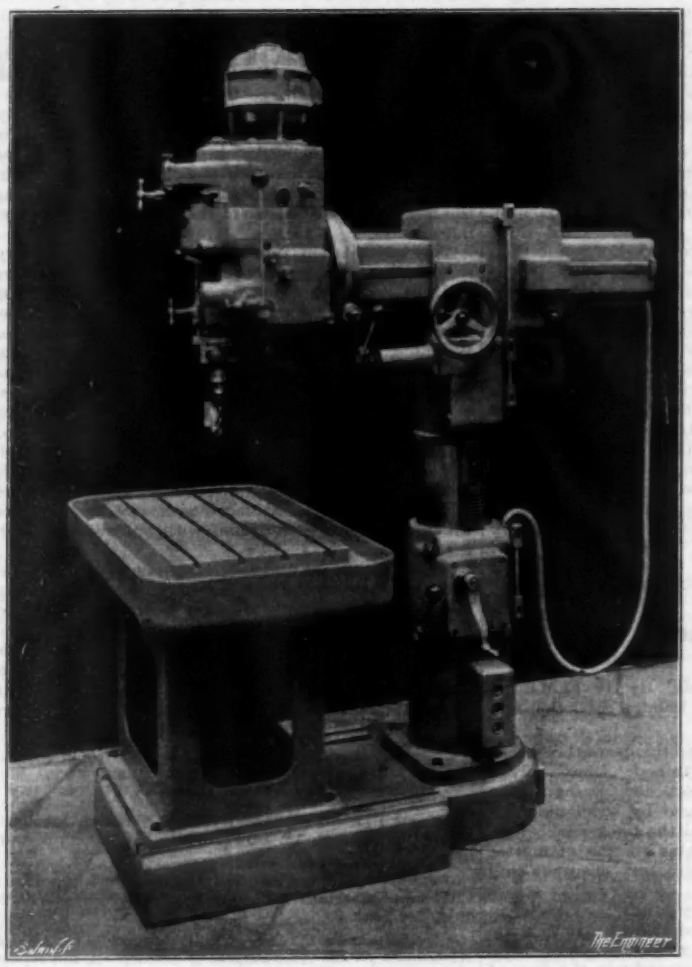


FIG. 17—HIGH-SPEED LIGHT DRILLING MACHINE—AUERBACH

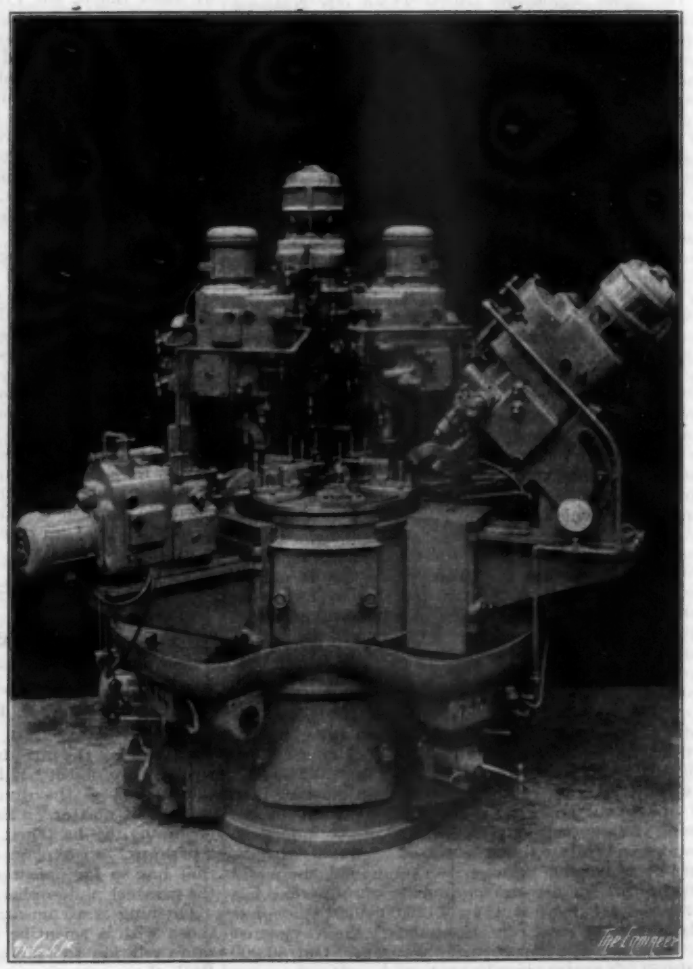


FIG. 18—FIVE-UNIT HIGH-SPEED DRILLING MACHINE—AUERBACH

Leipzig Technical Fair.

No. III.*

IN our 1930 and 1931 articles we indicated the general trend which has taken place towards the increased adoption of hydraulic drives. Several new machine tools embodying this principle were shown this year.

An interesting application of the hydraulic drive to milling machines was exhibited on the stand of the

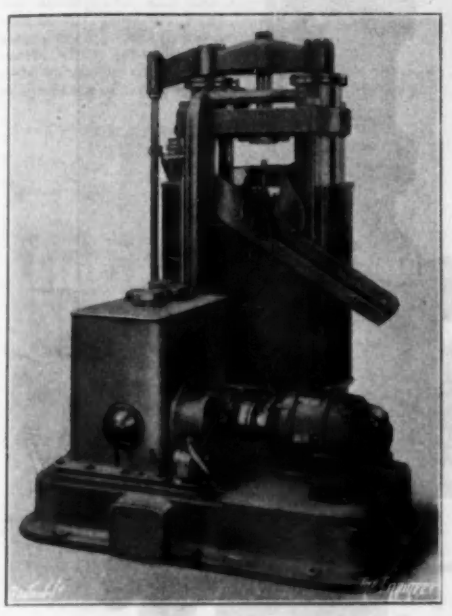


FIG. 19—BROACHING MACHINE—SCHUTTE

Wanderer-Werke, of Schönau, near Chemnitz. Fig. 15 shows this new machine. It has a hydraulically driven spindle, which can be varied in speed without steps between 20 and 1000 r.p.m. The primary oil pump can be worked either from a motor, attached directly to the frame of the machine, or by means of the usual belt drive, while the secondary drive in the hydraulic system is transmitted to the milling spindle by a spiral bevel gear on a spindle which runs

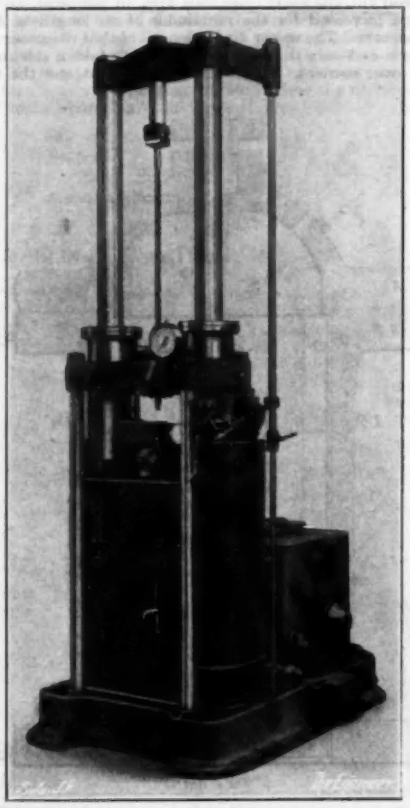


FIG. 20—BROACHING MACHINE—SCHUTTE

parallel to the main spindle, the arrangement being such that the milling cutter can be raised and lowered in a vertical direction. In contrast to the usual geared transmission, involving the use of about seven pairs of wheels working together, only two pairs are required which ensures very quiet running at high speeds. A tachometer on the spindle head shows the spindle speed, while an index finger attachment enables the correct cutting speed to be read off directly. A manometer indicates the pressure in the oil system, and so enables the cutting capacity of the machine to be regulated as desired, so that the operator can decide when the cutter needs to be reground. The table mechanism embodies the latest form of simplified controls and the machine can be easily adapted for high-speed light milling, or for heavier work when using either Widia or Stellite tools. The photograph reproduced in Fig. 16 shows a new horizontal miller with an improved form of head support, in which two side arms take the place of the more usual diagonal supports, and give a freer access to the work on the table. The time for setting up the machine is, it is claimed, greatly reduced by this new type of side support, which allows the table to be quickly lowered and raised. As our illustration shows, both the ends of the two arms are secured by clamping screws fitted into guide slots. When these arms are tightened, there is a pleasing freedom from vibration, even with heavy cuts. Single-lever controls for slow and fast feed and return, and for spindle speed and cooling fluid regulation are provided, the speed of the spindle being variable between the wide limits of 48 and 2100 r.p.m. In addition to these and other new models, several other standard types of Wanderer machines were exhibited in operation.

Improvements in drills and boring machines were also noted, and some very good examples of modern radial drills were to be seen on the Raboma, Alfred H. Schütte, Hillewerke, and other drilling machine makers' stands. The main direction of progress has, we noted, been in the simplification of the control arrangements, and the provision of low and high speeds with quick reverse, in some cases a single lever operating the clutch mechanism through a gate being employed. Even on the very large machines the radial arms are finely balanced, and can be moved by the finger, or, alternatively, firmly fixed by a clamping lever. Small drilling machines of more than usual interest were exhibited by the Auerbach und Scheibe A.G., of Saalfeld-Saale, which firm has specialised in the production of high-speed drilling units, which can be suitably adapted either singly or in combination to carry out simple or complex drilling operations. Figs. 17 and 18 show two new machines of this type, and well illustrate the application of the standardised units supplied by the firm. In Fig. 17 one unit on a swinging adjustable arm is shown, while in the other five standard units have been combined to work together with a revolving table on which component parts are successively drilled in five operations, one drill performing each operation, the work-table being automatically rotated from drill to drill. These units provide a spindle speed range of 375 to 6000 r.p.m., with a 1500 r.p.m. motor, or 750 to 12,000 with a 3000 r.p.m. motor in eight changes. There is a positive drive through one pair of gears, and the speed change only occupies 30 seconds. The spindle can be easily started or stopped by a single lever which controls the starter and the spindle brake, and arrangements are made for either hand, semi-automatic, or full automatic feed. The feed cams are quickly changed and the design permits the feed to be cut off in any position of the spindle. The specialised products of this firm are handled in Britain by E. H. Jones (Machine Tools), Ltd., Britannia Wharf, Baldwin-terrace, London, N. 1.

Another new machine which was the object of considerable interest was the vertical, hydraulically-operated broaching machine—see Figs. 19 and 20—which was exhibited on the stand of Alfred H. Schütte, of Köln-Deutz. This machine has been designed for semi or fully automatic working with a maximum pull of 10,000 kilos., or a little less than 10 tons. The oil pump is driven by a 15 B.H.P. 1500 r.p.m. motor through gearing, and it delivers oil under a pressure of about 18 atmospheres to the two vertical hydraulic rams which are connected at the top by a cross piece to which the special clutch for gripping and releasing the broach is attached. The work need not be touched by the hand of the operator and can be fed into the gripping device in which it is held. The end of the broach passes through the work and the broach is then raised by oil pressure until its end is gripped in the clutch. The working stroke now begins, and the broach is drawn up through the work by the rising rams. On the return stroke the oil is exhausted from the cylinders and the rams descend under their own weight, both the rams and the broach, which is automatically released, being oil cushioned at the end of the downward stroke. The work is automatically ejected and is passed by a delivery chute to the storage bin. The chute is shown at the back of the machine in Fig. 19. This view also indicates the neat arrangement of the motor-driven Enor pump. As will be gathered from Fig. 20, the operating controls and pressure gauges are grouped at the right-hand side of the machine, and the controls include a double piston valve for the rams and hand levers by which the speed of working and the stroke can be altered to suit different types of work. For automatic working stops fixed to a side rod are also provided. Owing to the small space taken up by the machine it is claimed that it can be conveniently placed, among other tools, to suit the flow of work.

The space at our disposal will not permit us, unfortunately, to deal fully with many of the novel machines we saw. The new Mulka automatic forming lathes with inclined feed, exhibited by the Loewe-Gesfürel A.G., of Berlin, created considerable interest; while on the neighbouring stand of J. E. Reinecker A.G., of Chemnitz, some improved grinding machines and automatic lathes were shown. Several machines, we noted, for the special production of motor car engines were exhibited, and among these were special cylinder boring machines and a combined vertical boring and honing machine, shown by L. Kellenberger and Co., of St. Gallen, Switzerland, on which only a single setting was required for the two operations, the respective tools being mounted at either side of a

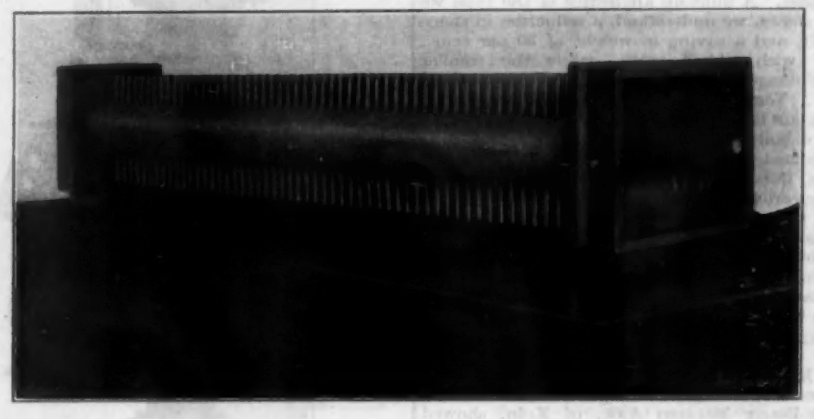


FIG. 21—AIR HEATER ELEMENT—LIEBEN

FIG. 22—AIR HEATER—LIEBEN

central pillar, with arrangements for bringing them successively into position over the work on the table. There was a good display of woodworking tools, both large and small, and some makers exhibited standardised components from which small works could build up the machines they required. A new development was the display of the Zeiss Ikon A.G., of Dresden, of a series of standardised components for press and punching tools finished with that high degree of accuracy for which the firm's astronomical instruments are noted. By the use of these standard components it is possible for firms to build up complete tools for press work in a few days, compared with the several weeks formerly required for the completion of such tools.

* No. II. appeared March 11th.

The firm also exhibited some fine examples of pressure castings.

Only very brief mention can be made within the scope of our present article of other sections of the Fair, excellent as some of them undoubtedly were. This year, again, the electrical exhibits in the Haus der Electrotechnik were very numerous, and they appeared to indicate no sign of trade depression in this branch of industry. Large displays of switchgear, cables, instruments, and smaller electrical apparatus and machinery, were staged by the larger firms, such as A.E.G. Company, Siemens Schuckert Werke, and Siemens Halske, and Brown Boveri et Cie, along with over two hundred smaller firms. The section devoted to prime movers contained little of new interest to steam engineers, but we saw one novelty which is illustrated in Figs. 21 and 22, shown by Liesen and Co., of Krefeld. It consists of an air heater, or economiser, in which closely spaced cast iron needles are utilised to form the heat transmission surfaces. The use of cast iron in this particular way is claimed to provide a much more durable and efficient surface than can be attained with ribs or like constructions. A built-up air heater of the type we illustrate shows, we understand, a reduction in space of one-half, and a saving in weight of 30 per cent., compared with ribbed tubes, while the smaller number of flanges and joints required gives increased reliability. Tests which have been officially carried out on an air heater working in conjunction with a Lancashire boiler have indicated very good results as regards heat transmission, with very little sooting up, owing, it is claimed, to the self-cleaning action of the gases around the needles.

Among the general engineering exhibits, we noted an extensive group of Demag suspension cranes, which showed the very handy way in which these small lifting units can be arranged in machine shops, warehouses, &c. They are made in capacities from 5 cwt. up to 3 tons, and the supports on which they travel can be easily erected in existing buildings. The firm also showed some of its patented Polyp grabs for lifting and dredging. Among the oil engine exhibits we saw several small high speed units. The Humboldt-Deutz Motoren A.G., of Koln, showed single and twin-cylinder engines of 5 B.H.P. up to 13 B.H.P., running at 2000 r.p.m. and 3000 r.p.m., while engines with single-lever control were shown by the Motorenfabrik Darmstadt. Other exhibitors in this section included Krupp, the Deutschen Werke, Kiel, and the Maschinenfabrik Augsberg, Nurnberg, which firm had several models of its latest engines. We noted that in practically all engines airless injection was employed.

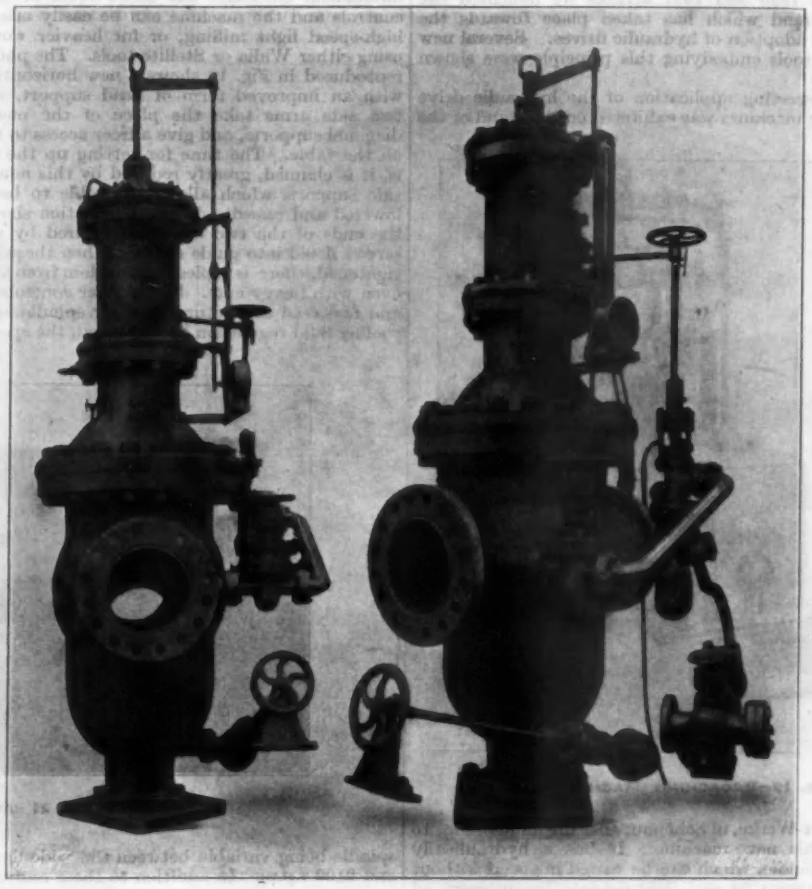
SIXTY YEARS AGO.

In our issue of March 22nd, 1872, we recorded the death of one who was intimately connected with the founders of our country's engineering industry. Mr. James Brown was born at Dundee on August 25th, 1790, and died "with that firmness and resignation which characterises the humble Christian" on March 13th, 1872. For more than fifty years of his long life he had been closely associated with the Soho Works, Birmingham, during which time he had enjoyed the personal esteem of Watt, Boulton, Southern, Murdock, Creighton, and many other eminent participants in the development of engineering. In 1817 he accompanied Watt in the "Caledonian," the first steamer to ascend the Rhine as far as Coblenz. In 1821 he was chief engineer of the "James Watt," when that steamer towed the "Royal Sovereign," carrying his Majesty King George IV., into Leith Harbour. In conjunction with Watt and Boulton he took an important part in establishing various steam packet companies, particularly in connection with the services introduced for carrying the Government mails. In addition, he provided the designs and drawings for many of the vessels used for the steam navigation of the Danube. In 1840 he became a partner in the firm of Boulton, Watt and Co., in which position he remained until the death of James Watt the younger in 1848. Thereafter he became a partner in the renamed firm of James Watt and Co., in which capacity he continued to serve until he retired in 1861. If it be true, as we recorded, that at the time of his death eleven years later he had outlived all his contemporaries, then this modest, retiring, and sincere man may justly be described as the last of the great engineering pioneers.

As an example of the human effects produced by engineering improvements in technical processes, Professor E. D. Smith, of Yale University, cited the case of two southern mills into which automatic looms were introduced. Both were small mills, which had had no labour difficulties, situated in slovenly and insanitary villages. Both were unorganised and slipshod. The engineers who studied the problem of introducing automatic looms in one of these mills did not stop their engineering there. They introduced better management, cleaned up the mill and the village, reduced hours and raised wages, developed new merchandise and new marketing facilities. By their careful attenton to the human phase of the problem they soon established a reputation for the mill as one outstanding in its treatment of labour, and no internal troubles have developed there. Engineering at the other mill ended with the introduction of the automatic loom. The old management, old working conditions, old hours, pay, and housing were left unaltered. In a short time there was dissatisfaction, followed by a bitter strike with all the pitiful consequences of such desperate measures.

HIGH-HEAD TURBINE INLET SLUICE VALVES

GLENFIELD AND KENNEDY, LTD., KILMARNOCK, ENGINEERS



High-Head Turbine Inlet Sluice Valves.

A SET of three 16in. diameter turbine inlet valves, which are intended to operate under a head of 3000ft. of water, has recently been designed and constructed by Glenfield and Kennedy, Ltd., of Kilmarnock. The valves, which embody a number of interesting features, are for use in connection with the Pykara hydro-electric scheme, which is being carried out in the Madras Presidency by Balfour, Beatty and Co., Ltd., of London, to the designs of Major H. G. Howard, Engineer to the Madras Government. As a first instalment of this undertaking, three Pelton wheel units, each of 10,500 H.P. capacity, are being put in, and it is for those machines that the valves which we are about to describe are required.

The valves have actually been designed for a maximum working pressure equal to that due to a head of 3384ft. of water, so as to include a margin for surges of 10 per cent. or so above the maximum static head. They were, before dispatch, subjected to a test pressure equivalent to that due to 5060ft. of water, or nearly 1 ton per square inch. The valve cases, in view of the heavy operating pressure, are of thick cast steel, and, as will be gathered from the half-tone engraving above they are of particularly robust construction. The operation is by hydraulic cylinders, and the pressure water for each of the cylinders of the three valves is drawn from a 'bus supply pipe, which is connected to each of the three penstocks. A reflux valve is fitted on each of these connections, so that the highest pressure existing in any one of the penstocks will automatically be available in the 'bus pipe to operate the valves. It will be realised that this provision, which is comparatively novel, is of value should it be necessary to operate a valve on a penstock which may happen at the time to be empty, for, obviously, if pressure connection is only made between each valve and its own particular penstock, it would not be possible to operate that valve hydraulically if the penstock were empty.

The valves are designed to open with full unbalanced pressure on one side of the door, and atmospheric pressure on the other, and, similarly, to be closed when discharging under full head to atmosphere. Drawings of the hydraulic operating cylinder and its piston are given in Figs. 1 and 2. The cylinder itself is of cast steel. It is furnished with a gun-metal liner, $\frac{5}{8}$in. thick, which is bored to an internal diameter of 14$\frac{1}{2}$in. The piston is, as will be observed, of very massive construction. It consists of a cast iron body, 14$\frac{7}{8}$in. in diameter and 6$\frac{1}{2}$in. deep, recessed at its upper end to receive a cast iron junk ring of the same external diameter, which is secured to it by eight screwed studs, 1$\frac{1}{2}$in. diameter, and nuts. Both piston body and junk ring have formed in them, at $\frac{1}{2}$in. centres from their upper and lower surfaces respectively, a groove machined to a $\frac{1}{16}$in. radius, and into each groove is sprung a $\frac{1}{8}$in. diameter circular rubber cord. L-shaped cup leathers are, as will be seen in Fig. 2, arranged to fit over these rings, the cups being separated from one another by means of a specially shaped gun-metal distance ring, through holes in which, and through the cup leathers, are threaded the studs securing the junk ring to the piston body. Ports are formed at four points round the circumference of both ring and piston to enable pressure water to find its way to the interior surfaces of the cup leathers, and we understand that the whole arrangement has proved to be most satisfactory.

The piston is bored with a central hole through which passes a steel shaft, the lower end of which operates the turbine inlet valve. The upper end of the shaft is 4$\frac{1}{2}$in. in diameter, and it is screwed for a length of rather over 5in., with six threads to the inch, so as to take a steel nut, 8$\frac{1}{4}$in. over corners. For a further length of between 6in. and 7in. the shaft continues 4$\frac{1}{2}$in. in diameter, and it is then increased for the remainder of its length to 5in. in diameter. The upper 5in. in length of that diameter are also screwed—six threads to the inch—to take a steel nut, 8$\frac{1}{4}$in. over corners. Between the upper nut and the top face of the piston is a ring, 8$\frac{1}{2}$in. in diameter, which is keyed in position on the piston by means of a grub screw, $\frac{3}{4}$in. in diameter. The top and bottom nuts are screwed up tightly so that they, the shaft, and the piston form one rigid body. The upper end of the shaft is bored with a hole of 1$\frac{1}{2}$in. in diameter, which is threaded 1$\frac{1}{2}$in. gas to take the lower end of a steel shaft connected with an external indicator mechanism, which shows, by means of a pointer on a graduated scale, the extent of opening of the valve.

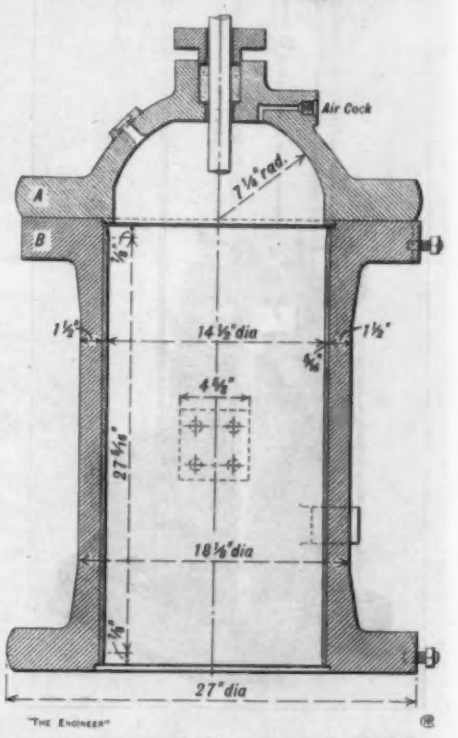


FIG. 1—HYDRAULIC OPERATING CYLINDER

It will be readily understood that, with such a heavy

working pressure and such severe conditions of operation, it was necessary to employ special materials for the door and seat faces of the main turbine valves. Both faces and seats, which were made particularly broad, so as to reduce unit bearing pressure to a minimum, are solidly recessed and pinned in position. The bearing faces on the door and body on the downstream side are made of dissimilar, specially selected hard bronzes, while the upstream faces, which do not take any pressure, but have only to withstand corrosion, are of gun-metal.

When actually fixed in position at the site, the valves will not be arranged with their operating spindles vertical, but slightly at an angle, as seen in Fig. 3, which shows the main valve and the accessories necessary for its operation. The valves are to be remote-controlled, the arrangements embodying a pair of solenoids and a pilot valve, which controls the supply of pressure water to a slide valve, by which the water is admitted to one side or the other of the main operating piston. The pilot valve

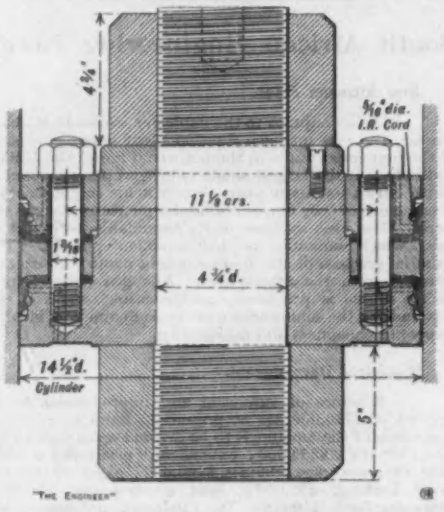


FIG. 2—PISTON FOR OPERATING CYLINDER

is of the firm's "Homeyard" type, and to its action we shall refer immediately. Meanwhile, it may be explained that the effect of pressing the "opening" push-button is to energise one of the pair of solenoids which pulls over a short lever on a "Homeyard" valve. That motion causes pressure water to pass through the valve and to be admitted to the top end of a cylinder, the piston of which operates a double-ported slide valve—Fig. 4. It should be explained that this slide valve remains ordinarily in the closed position because there is constantly a pressure on the lower side of its operating piston, which is caused by leakage of pressure water past its spindle. When the slide valve is forced down, as mentioned above, by the admission to the upper side of its piston of pressure water from the pilot valve, pressure water is admitted through one of the ports to the top of the piston of the main turbine inlet valve, and at the same time the underside of the main operating cylinder is thrown open to exhaust. The result, of course, is that the main piston is forced downwards and the turbine inlet valve is closed.

To open the main turbine inlet valve a second push button on the control board is pressed, and the second of the pair of solenoids is energised. That operation has the effect of causing the pilot valve to cut off the supply of pressure water from the top of the operating cylinder of the slide valve and of opening the top of that cylinder to exhaust. The pressure which, as pointed out above, is constantly exerted on the underside of its operating piston causes that piston to rise and raises the slide valve into such a position that its second port allows pressure water to be admitted to the lower part of the main turbine inlet valve cylinder and opens the top of that cylinder to exhaust. The result is that the main valve is opened.

The principle on which the "Homeyard" valve acts is shown in Fig. 5, which represents a valve of the single-ported type, such as those that are to be used at Pykara.

The valve consists of a body A bored out to receive two stainless steel spindles B_1B_2, one of which acts as a pressure valve and the other as an exhaust valve. These two spindles are coupled together at their top ends by means of a tee-shaped common connecting link lever C and cross-heads D D. At the middle point in the link C are fitted a pin E and two side links F F, which lie at each side of the valve body, and are connected at their lower ends by a

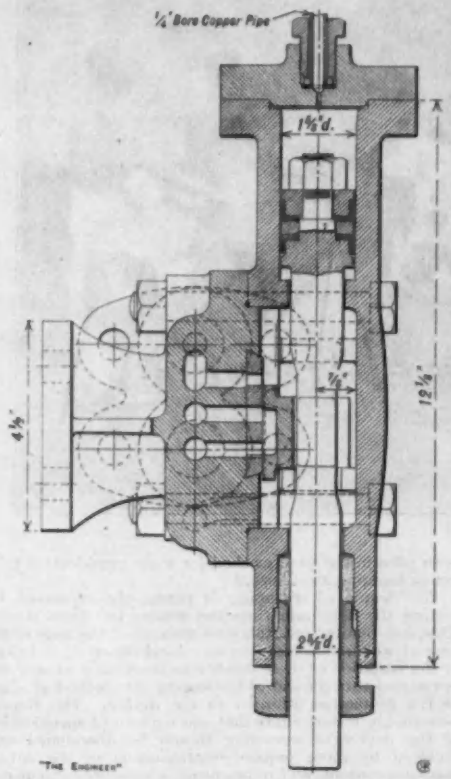


FIG. 4—DOUBLE-PORTED OPERATING VALVE

crosshead G. This crosshead is attached to a small ram H, the cylinder of which is bored vertically upwards from the bottom of the valve body. Pressure water is led to the top of this ram H through a small passage I leading from the inlet chamber of the valve. A constant downward pressure is therefore exerted on the ram H, which pressure is transferred through the side links F F and lever C to the valve spindles B_1B_2. As these spindles have themselves pistons of exactly the same area at top and bottom, and are therefore in equilibrium, the constant thrust from the small ram H tends to keep the valves formed on spindles B_1B_2 closed. It will be observed that movement to one side or the other of the lever C raises or lowers the spindles B_1B_2 and their valves respectively, the valves at rest on their seatings at any moment forming the fulcrums for the time being.

In operation, when the upper end of the lever C is moved to the right, valve B_1 is raised, the valve B_2 remaining on its seat. Pressure water, entering through the branch, passes through the valve B_1, across past the valve B_2, and then to the upper side of the piston of the double-ported slide valve. Again, when the lever C is moved to the left, valve B_2 is raised and valve B_1 acts as the fulcrum. The top of the cylinder of the double-ported slide valve is then in direct communication with the exhaust through the open valve B_2, and the slide valve then moves upwards under the influence of the constant pressure below its piston as described above.

The movement of lever C is controlled by solenoids, energised through push buttons situated at a remote position, as already explained, or by a removable handle at the valve. There is also an arrangement by which, in the event of overspeed of the turbine, the pilot valve can be operated by means of an emergency governor. The arrangement of this valve and its operating solenoids is shown in Fig. 6

The accessory equipment of each main turbine inlet valve includes a 3in. diameter needle valve to control the supply of water to the braking jet of the Pelton wheel.

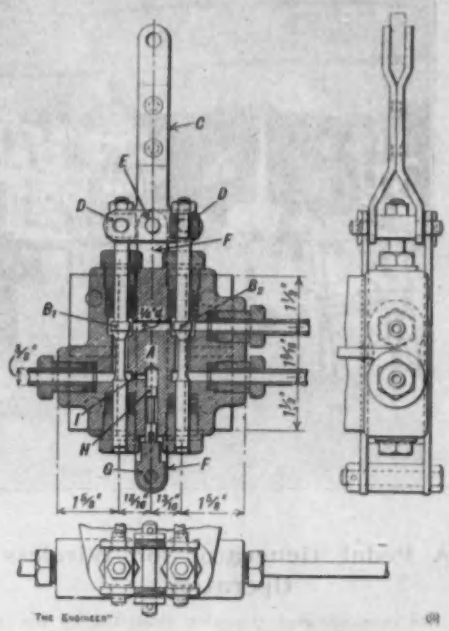


FIG. 5—"HOMEYARD" PILOT VALVE

This valve has ball bearings to reduce the power required to operate it, and its needle and screw are of high-tensile forged manganese bronze. There are also 2in. needle valves to act as by-passes and drains. The by-pass is protected by a guard valve of the "spectacle eye" type, which is normally kept in the full open position with the follower ring, or "spectacle eye" drawn up, and completely covering the valve seats so as to protect them from erosion. The valves—main and auxiliary—are so designed that their glands can be packed under pressure, so that it is not necessary to shut down the pipe lines for that purpose.

In addition to the static pressure test above mentioned, the valves were each tested by moving the doors over their respective faces with full static head on the upstream side, so as to make sure that the operating power was ample for its work, and also that the bearing pressure which had been allowed between the faces gave a generous factor of

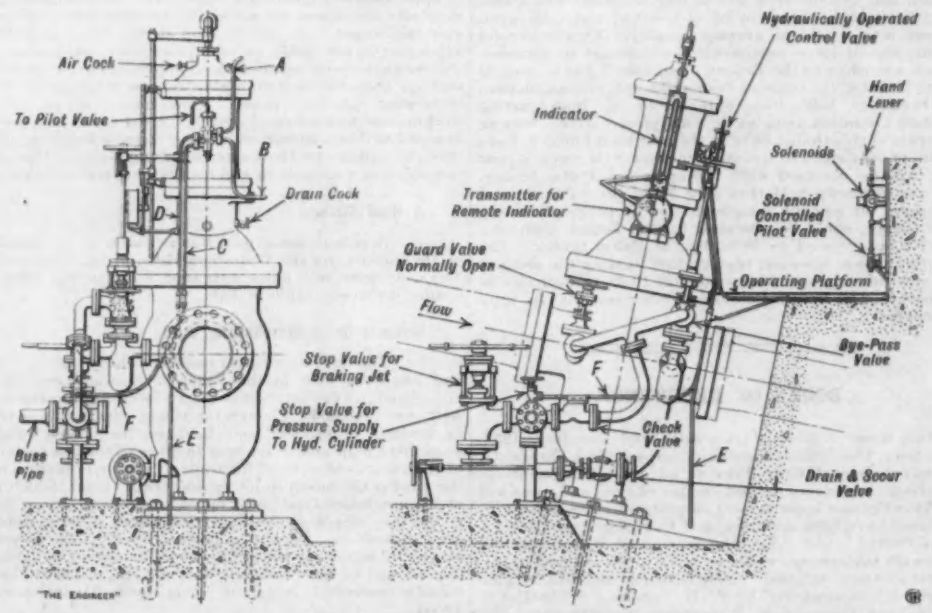


FIG. 3—MAIN VALVE AND ACCESSORIES

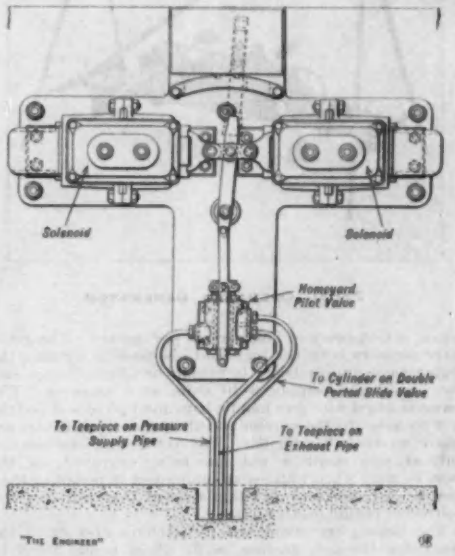


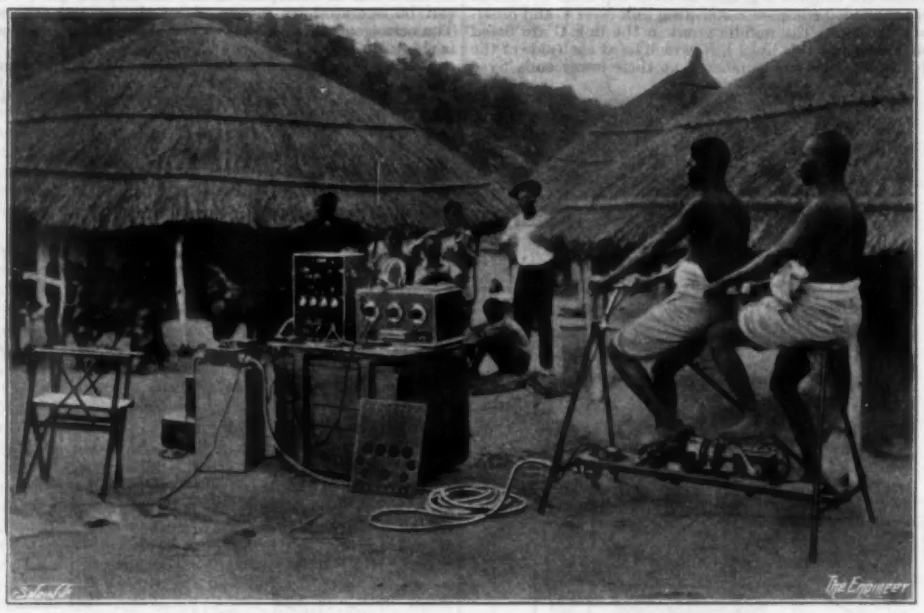
FIG. 6—EMERGENCY CONTROLS OF PILOT VALVE

safety. We are informed that the valves passed all tests to which they were subjected satisfactorily. It is interesting to note that each main valve alone, without its piping or auxiliary valves, &c., weighs 7 tons.

ACCORDING to Mr. J. B. Umhau, of the American Bureau of Mines, one part of cadmium will displace two parts of tin in solder, but it is questionable whether cadmium in solder gives any mechanical advantage; moreover, any substantial new demand for cadmium would undoubtedly make the price prohibitive, so that the chance of it becoming an effective substitute may be regarded as exceedingly small, the facts being that the present output of cadmium is of the order of 2000 tons a year, while the world's normal demand for tin for solder certainly exceeds 35,000 tons, and probably amounts to 40,000 tons a year.

A PEDAL GENERATOR FOR WIRELESS OPERATION

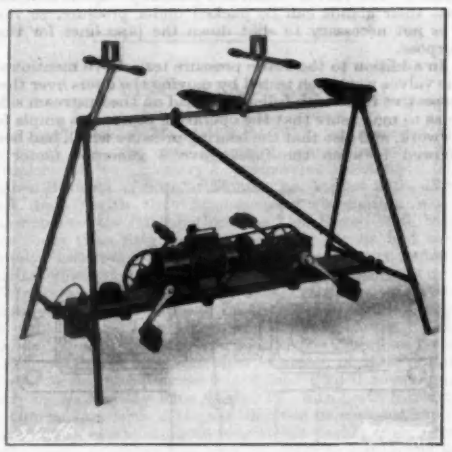
MARCONI'S WIRELESS TELEGRAPH COMPANY, LTD., LONDON, ENGINEERS



A Pedal Generator for Wireless Operation.

THE pedal-operated generator illustrated by the engravings is used to provide power for a Marconi type transmitter and receiver supplied for use in Northern Rhodesia. This form of installation is intended to link up by short-wave wireless the many isolated administrative posts in the territory with each other and with Government headquarters. During tests satisfactory communication was maintained over distances up to 500 miles, despite difficult atmospheric conditions.

The power plant consists of a tandem pedal-driven generator fitted with interrupter gear to provide I.C.W.



PEDAL-OPERATED GENERATOR

giving a frequency of 750 periods per second. The generator supplies both the high and low-tension circuits, the high-tension supply being 1000 volts at 130 milliamps and the low-tension supply 9–10 volts at 6 ampères. The frame is fitted with two handle bars and two sets of pedals, and to indicate the correct pedalling speed voltmeters are fitted on each handle bar. The voltmeters are marked only at one point, a red line being engraved on the face, so that when natives are employed in pedalling they can be instructed to maintain a speed that will keep the voltmeter needle on that line.

The pedals are connected by a chain and drive the generator through gearing, a fly-wheel being fitted to ensure a steady output. The generator can be driven continuously without undue exertion while communication is carried out, and it is said that the native pedallers thoroughly enjoy this new form of physical exercise.

The transmitter—the left-hand instrument on the box in the centre of the upper engraving—is a Marconi aircraft transmitter with a wave range of 40–60 m., and the receiver is a Marconi instrument with a wave range of 10–200 m.

TIMBER RESEARCH.

THE Annual Report for 1930 of the Forest Products Research Board of the Department of Scientific and Industrial Research, issued recently—H.M. Stationery Office, price 4s.—draws attention to the desirability of a more rigorous definition of the term "properly seasoned" timber. "Hitherto," the Report states, "the general method of seasoning sawn timber has been to stack it in open piles in the yard or shed for some considerable time before bringing it into use."

The degree of seasoning is commonly expressed by stating the minimum time the timber has been stored. This, it is pointed out, takes no account of the time of the year at which seasoning begins; local climatic conditions or the variation of these conditions from the normal; the initial moisture content of the wood; the method of piling or the protection afforded to the timber. The Report accordingly recommends that the haphazard specification of the degree of seasoning should be abandoned and replaced by more precise determination of the actual moisture content, and recommends a moisture content not exceeding 25 per cent. for general carpenter's work, down to 12 to 9 per cent. for the best joinery and panelling work, block flooring, &c., in the case of centrally heated buildings, as against 14–10 per cent. for buildings not so heated. Where the wood is to be treated with preservatives the moisture content should not be higher than 20 per cent. in order to allow proper impregnation.

The Report describes how the defect known as "collapse"—that is, severe shrinkage—met with in certain timbers can be removed by a simple reconditioning process which had been previously successfully used in Australia. The process consists of warming the timber to 210 deg. Fah. for four hours and then rapidly cooling it. In this way a commercial consignment of Tasmanian oak which had become very wet during shipment was transformed from a collection of ill-assorted and misshapen pieces into a pile of average quality. This successful result should have considerable commercial importance, since, according to the Report, "collapse" was so general as to threaten the trade in Tasmanian oak with extinction.

Owing to difficulties experienced in impregnating British Columbia Douglas fir with preservatives, railway sleepers of this timber have in the past been found to have a life of only eight to ten years instead of the twenty-year life usually obtained with the creosoted Baltic timber. It was generally held that only 3½ lb. per cubic foot of creosote, an amount insufficient for properly protecting the timber, could be absorbed by the British Columbia timber, as opposed to 10 lb. by the Baltic timber. The Report shows, however, that by first incising the sleepers by rows of staggered knives the full 10 lb. or over can be injected. The British Columbia timber can thus be fully protected.

BOOKS OF REFERENCE.

The Water Engineers' Handbook and Directory, 1932. London: The *Colliery Guardian* Company, Ltd., 30 and 31, Furnival-street, E.C. 4. Price 8s. 6d. net.—This handbook has been extensively revised for this edition, and users will find it a distinct improvement on previous issues. Hitherto sections have been included on "Pumping Machinery for Waterworks" and "The Purification of Water," which, although interesting, were too brief to be of great value. They are now omitted. New features include "Water works Administration," by W. H. Parsons; "The Use of Reinforced Concrete in Waterworks Construction," by H. C. Ritchie; "The Rating of Waterworks," by E. Witton Booth; and "The Chemical Treatment of Water." The care with which it has been edited and the value of the information it contains will find this little volume a definite place in the offices of all connected with water engineering.

The Mining Year Book, 1932. By W. E. Skinner. London: Walter E. Skinner, 15, Dowgate-hill, E.C. 4. Price 20s. net.—All connected with the mining industry are acquainted with this book of reference, and the arrangement of the present edition—the forty-sixth—follows that of previous issues, all the information having been brought up to date and in some cases enlarged upon. Some 1285 companies are dealt with, and the supplementary index with its references to earlier volumes covers a further 687 companies. Throughout the book it is evident that the compilers have stinted neither time nor trouble in finding essential details of all progress in the mining industry, and they have produced a volume full of interesting and valuable information.

Sell's Directory of Telegraphic Addresses, 1932. London: Business Dictionaries, Ltd., 8 and 9, Johnson's-court, Fleet-street, E.C. 4. Price 45s. net.—We welcome the forty-seventh edition of this well-known volume. In one section some 100,000 firms are listed with their full address, telegraphic address, and telephone number; in another section they are arranged under over 3500 trade headings. We have many times in the past drawn attention to the ever-increasing value of "Sell's." The new edition has already rendered itself indispensable in these offices, and we unhesitatingly recommend it to all firms for reference purposes.

South African Engineering Notes.

New Nitrogen Plant.

As an adjunct to the explosive works at Modderfontein, the new nitrogen fixation plant assumes a place of the first importance in the industrial life of the Union. Not only is it the largest single industrial plant erected in South Africa for many years, but it holds the distinction of being one of only five or six similar plants existing in the world. The best measure of its formidable nature is its cost, which amounts to half-a-million pounds. The essential purpose of the Modderfontein plant is to extract nitrogen from the atmosphere. Nitrogen derived from such a source is practically inexhaustible, and the raw material for the manufacture of its compounds is ideal in respect of cheapness and availability.

Municipal Development.

Schemes of extension and improvement to an amount of £710,000 are at present in hand in Pretoria. The whole of the amount is to be divided up as follows:—New City Hall, £250,000; extension of electricity service, £250,000; sewerage schemes, £100,000; eight bridges and street kerbing, £50,000; road construction, £50,000; swimming bath, £10,000. The Finance Committee of the Johannesburg City Council will suggest that the £1,000,000 loan that is being raised be allocated as follows, the net proceeds of the loan being £985,000:—Rand air port, £42,500; baths, £20,000; crematorium, £5000; electricity, £33,301; fire station, £48,919; gas, £50,000; native locations, £150,000; roads, £23,000; sewerage, £270,230; storm water drains, &c., £125,000; and tramways, £75,000.

New S.A.R. Workshops.

The three new railway workshops in course of construction at Bloemfontein are expected to be ready in March or April next. The points and crossings and signals shop was authorised in 1929. The manufacture of points and crossings and signal work of all descriptions now carried out in the Salt River workshops will in future be undertaken in the new shops at Bloemfontein, which is geographically centrally situated and will then provide for more economical distribution of output. The opening of this shop will necessitate the transfer from Salt River of approximately ninety-six employees. At the time this shop was authorised a considerable increase was expected over the output from the old shop at Salt River, but this expansion is not likely to take place until the traffic of the railways shows a considerable improvement. The new carriage shop and saw mill, also the new wagon shop are both what may be termed "replacement" shops. The workmen at present employed in the old coach shop and saw mill at Bloemfontein will occupy the new building, and this also applies to the wagon shop employees. The old carriage and wagon shops and facilities are not up to date.

A Gold Strike.

A rich strike of gold was reported in the middle of December from the Waterberg Hills, in the Transvaal. The new strike is 7 miles distant in a direct line from a similar discovery made in July.

Union's Great Marshalling Yard.

The largest and most modern railway marshalling and reception yard in the Union is that at Gun Hill. Completed in October, it cost the Railway Administration well over £100,000. Though the whole scheme is not yet in working order, sufficient facilities have been made available by the end of the year to allow of the last section of the yard to be opened for traffic. The main feature of the yard is the hump shunting and track circuit, which is of the non-token type, working on single lines. Gun Hill is the only depôt in South Africa where these systems are in operation. Another important device is the special automatic signalling which has been introduced to cabins at each end of the yard. By this system, which is electrically controlled, foolproof safety methods are introduced.

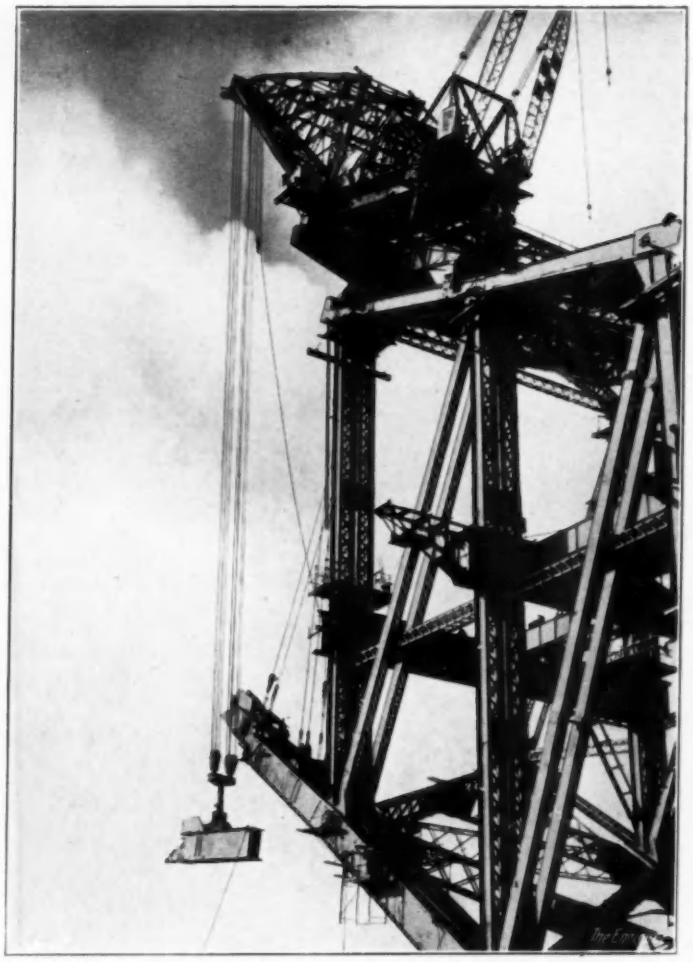
Railway Bridges in the Free State.

In connection with the strengthening of bridges and culverts on the Free State and Cape Western main lines, in order to permit of heavier axle loads, steel work for major bridge requirements has been arriving from overseas in large quantities since last October, and bridge gangs have been transferred to undertake the erection and replacement work. Very little actual progress can be reported at the present time, as sorting, stacking, and the establishment of depôts have been the chief concerns of those engaged in the work. It is expected, however, that the work will soon be in full swing. The spans to be replaced vary in length from 15ft. to 100ft. Among the major bridges to receive attention on the Free State main line are the Rhenoster River, three 100ft. spans; Modder River, four 100ft. spans; Vet River, five 100ft. spans;

SYDNEY HARBO

CONSTRUCTED BY DORMAN, LONG AND

CREEPER CRANE ERECTING FIFTH PANEL, SOUTH SIDE



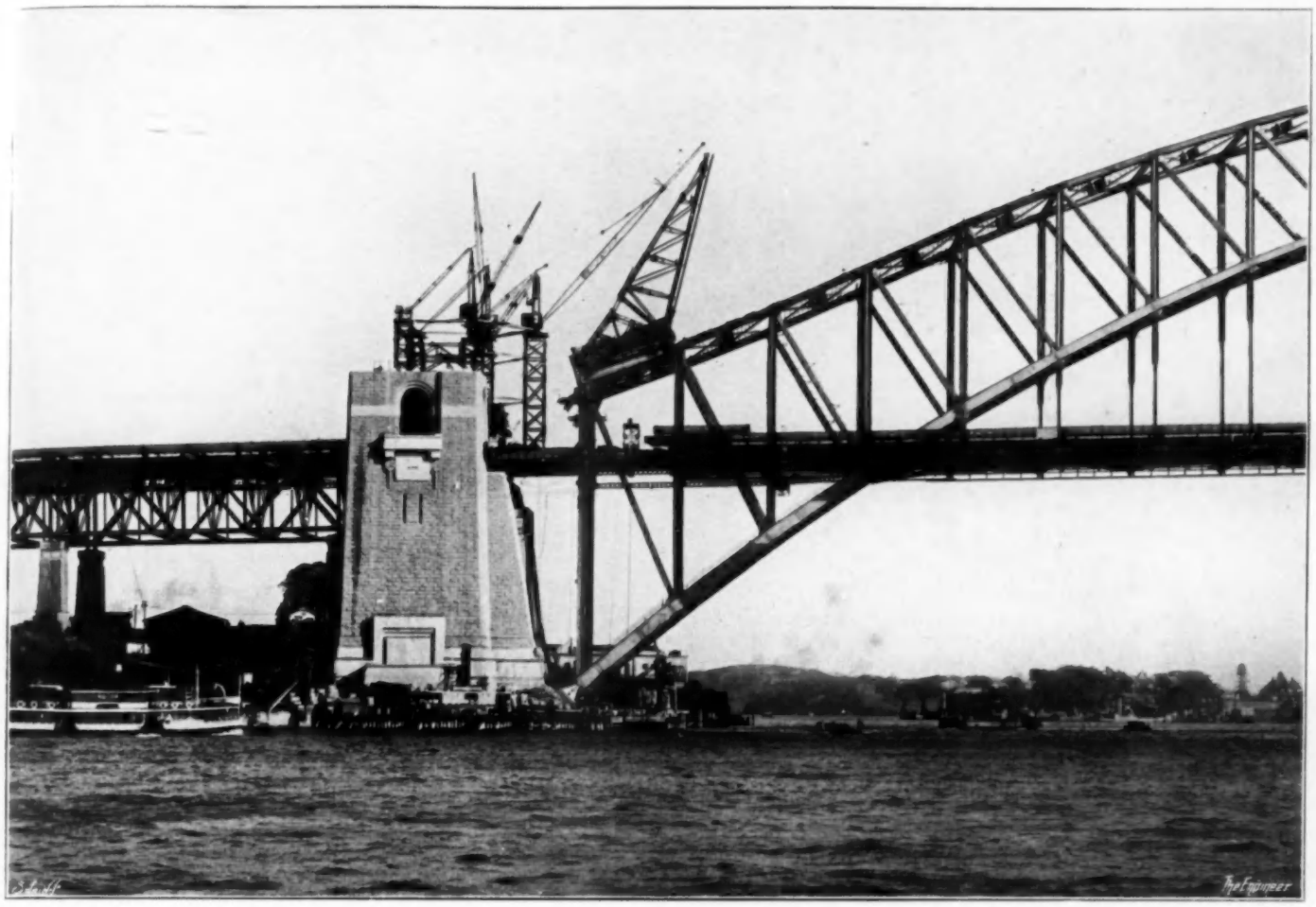
THE CREEPER CRANE AT WORK

CLOSING-MEMBERS OF LOWER CHORD

UNIV. OF MICH.

HARBOUR BRIDGE

, LONG AND CO., LTD., MIDDLESBROUGH



ARCH COMPLETED AND CREEPER CRANE BEING DISMANTLED

VIEW FROM SOUTH-EAST PYLON TOWER

VIEW SHOWING CENTRAL ROADWAY

UNIV. OF MICH.

Sand River, five 100ft. spans; Bloemspruit, three 100ft. spans; Valsch River, five 100ft. spans; Taaibosch River, three 75ft. spans; and three single 100ft. span bridges. Large bridges involved on the Cape Western main line, from Beaufort West northwards, are the Modder River, eight 80ft. spans; Gamka River, two 80ft. spans; Krom River, one 100ft. span; and one 100ft. span bridge and two 20ft. span bridges at Merriman.

Natal Coal for Far East.

There has been a considerable revival in the Natal coal export trade recently, and there are signs that the developments in the Sino-Japanese fighting is responsible. It is significant that since the Manchurian trouble started in November there has been an increase of coal exporting to Singapore and Hong Kong. From January last year to October there was an average shipment of 6000 tons of Natal coal to Singapore, but in November it trebled itself to 20,000 tons, and in December increased considerably. Similar figures are available for the export of Natal coal to Hong Kong. These figures refer to only a section of the former export markets for Union coal, and the tonnages shipped to Hong Kong, Singapore, and Saigon are nothing like as big as the previous markets of India, which are now closed, and the Suez, which is buying smaller quantities because of Britain's exchange advantage.

Alcohol from Maize.

A company formed with the object of manufacturing alcohol from maize was registered at Pretoria recently. It is called the South African Exploration and Finance Company (Pty.), Ltd., with a capital of £5000. It has purchased registered patent processes for the manufacture of alcohol from maize, maize cobs, and various vegetable and other matter, and also for the manufacture and production of various by-products, including ethylene, fertiliser, cattle feed, and yeast.

Diamond Mines Position.

Continued world depression has placed the diamond mines in an admittedly precarious financial position. Sir Ernest Oppenheimer, the chairman of De Beers, states that it is obvious that the mines will have to close down if they cannot sell their diamonds, but the Government is fully alive to the dangers confronting the industry, and he is confident that everything possible will be done to protect the industry and to prevent unemployment and hardship to employees.

Port Elizabeth Harbour.

Operations on the construction of the first portion of the Port Elizabeth Harbour under the Craig scheme are progressing rapidly. This work consists of the construction of the northern rubble mole to a distance of about 2000ft. and the extension of the existing north jetty by 800ft. in solid concrete block work, after which the existing portion of the north jetty will be similarly made solid. The big crane which is to lay the concrete blocks of the jetty extension has now been erected at the heads of the jetty and will begin laying blocks almost immediately. In the construction of the northern rubble mole about 700ft. of the timber staging and rails have been laid, so that the concrete blocks for the outside face and the spoil for filling in behind can be conveyed where required and 19,500 cubic yards of rubble and dredgings have been dumped. About 12,000 cubic yards of dredging for the quay wall foundations at the north jetty have been done. In the closing up solid of the Dom Petro Jetty to the south 2045 5-ton blocks and 968 cubic yards of rubble have been dumped.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

COOKER CONTROL UNITS.

No. 438—1932. This specification covers cooker control units for use in two-wire circuits of not more than 250 volts declared pressure. The units are intended for domestic electric cookers and consist of a switch for controlling the current to the cooker, together with an auxiliary circuit by means of which an iron, kettle, or other appliance may be used simultaneously or independently of the cooker. Its aim is to define the minimum requirements as regards the components and general arrangement of the control unit, without unduly restricting the manufacturer in the development of new designs. The specification has been drawn up in such a way as to keep down the price of the article as far as possible, consistent with safety and mechanical robustness.

SOLDERS.

No. 219—1932; No. 441—1932.— Primarily in order to make provision for the incorporation of a further grade of solder, Grade K, suitable for certain classes of machine soldering, a revised edition of the British Standard Specification for Soft Solders, No. 219—1932, has just been issued The compositions of the grades A to J remain unchanged, though modifications have been made in some instances in the references to the uses for which the solders are primarily intended. Some additional provisions have been made in the clause relating to the chemical analysis of samples.

A new British Standard Specification for Cored Solder, Rosin Filled, No. 441—1932, has also been issued. It provide for six standard sizes ranging from 8 to 16 S.W.G., and contains clauses regulating the composition of the solder and of the quality and proportion of the rosin, with provisions for the sampling of the material for examination and analysis.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

THOUGH production at some of the works in the Midlands and Staffordshire shows an upward tendency, and although there is a growing confidence in the future, the market position in Birmingham gives no sign of awakening from the inertia which has prevailed for some weeks past. The trades in which activity prevails are varied, but firms have in almost every case stocks of material sufficient to carry them on for some time, and there is no need to enter into fresh commitments. Very little business was transacted on 'Change this week, but producers are holding firm to late selling rates. They are hoping for an early improvement in demand to enable them to clear some of their—in many cases, heavy—stocks. The coming of the spring season should exercse a beneficial effect on a number of the lighter Midland industries and should eventually result in a greater call for iron and steel and other materials. The heavy engineering trades continue depressed, but there is more movement amongst automobile engineers. Firms supplying components are accordingly becoming busier. The light foundries are slightly more active. Electrical engineers are busy, and the hardware and hollow-ware trades report a movement, which is gradual, but in the right direction. Where there has been any alteration in the trade position in this area during the week, it has been for the better. That is the most that can be said.

Trade Movement.

There is increasing employment in many Midland trades, and the outlook, particularly for Birmingham, is regarded as brighter than it has been for some time past. The information regarding the establishment of new factories and the extension of existing ones, published by the Birmingham Information Bureau, has led to a rise in optimism, alike amongst manufacturers and workpeople. It is officially affirmed that new factories will shortly be commencing production in the City. One firm will manufacture metal castings of all types, and in particular will make pistons for the motor trade from a new French low-expansion aluminium alloy. This alloy is already extensively used on the Continent, but until now it has not been employed in this county. An adjacent factory has been taken by a firm of machine tool makers. There is a growing demand for tubular steel furniture, and a firm which recently secured the manufacturing rights in this country for the production of furniture previously imported from Germany states that its staff is being steadily increased. A firm manufacturing aluminium hollow-ware, which has opened accounts in several territories previously closed, and, in particular, Portugal, has brought out a new range of lines which will appeal to foreign countries. A process of great importance to the aluminium hollow-ware industry by which a chromium-plated finish is given to aluminium ware, was revealed at the British Industries Fair this year. As a result of the interest displayed in the process there, a Birmingham firm, which owns the exclusive rights to the process in this country, is doubling its staff, while its factory, which is at present being rebuilt, is being equipped to enable the production capacity of the old works to be more than doubled. The manufacture of vacuum flasks, which was previously an almost complete German monopoly, has recently been commenced in Birmingham by the same firm, and an increasing demand for these goods is being experienced in the home market.

The Birmingham Exchange.

With the help derived from the departure from the gold standard, and the tariff duty on iron and steel, Mr. H. Bertram Hingley, the President of the Birmingham Exchange, thinks iron and steelmasters will now have a better chance of competing against the flood of imports which they had been unable to stand up against for years past. In moving the adoption of the report at the annual meeting of the Birmingham Exchange, he expressed this view after what was, perhaps, the most depressing yearly statement for the past three years. During 1931, Mr. Hingley stated, the coal, iron and steel trades had all suffered to a serious extent. Exports of coal suffered a shrinkage of 16,000,000 tons, as compared with 1930. The coal production as a whole in Great Britain in 1931 was approximately 24,000,000 tons less. Pig iron production had shared in the depression, there being a drop of nearly 2,500,000 tons, as compared with 1930, and of 6,500,000 as against 1913. In South Staffordshire, out of twenty-four furnaces, only six were in blast; in Northamptonshire, eight of seventeen, and in Derbyshire, eleven out of eighteen. The year's production of pig iron was 3,750,000 tons, being the lowest figure recorded during this century, except in "the strike" year, 1926. We produced 2,000,000 tons less steel in 1931 than in 1930, and while imports of iron and steel were much greater than in the preceding year, exports were considerably less. Wrought iron had been disappointing. There had been a moderate demand for the better grades and specialities, but for the ordinary bar iron the demand had been poor with severe competition for the quantities rolled.

The Future of Electricity.

Mr. Frank Hodges, a member of the Central Electricity Board, at the twenty-first annual dinner in Birmingham of the Birmingham Electric Club, expressed the opinion that in the next two or three years this nation will have become the leading electrical country of the world. They had witnessed, he said, a growth of electrical generation and consumption in this country more rapid and greater than in any other country in the world. Great Britain's increase during the last five years was 34·9 per cent. In the United States it was 16·3 per cent., in Germany 14·6 per cent., in Canada 12·6 per cent., and in Italy 21 per cent. If they took the last two years, despite the period of industrial depression through which they had passed, they could claim, relatively and absolutely, to have gone ahead of the whole world. He dealt with the work of the Central Electricity Board, and said that it had practically completed the contract side of its work, and by the spring of 1933 it would have erected practically every tower and line from the North of Scotland to the West of Cornwall. The last tower in the 430 miles of high-tension transmission lines, and the last tower in the low-tension system, had been erected. Moreover, the eighteen substations had been completed.

Production Figures.

Though industrialists in this area expected an adverse report concerning the February production of pig iron, demand having been notably poor during the whole of the month, they, nevertheless, regret to find that there has been a net reduction of five in the number of active blast-furnaces as compared with a month ago. There are now seventy-one furnaces in operation throughout the Kingdom, but only a small number of them are in the Midlands. The output of pig iron last month, it is noted, amounted to only 318,100 tons, compared with 330,000 tons in January, and 318,200 tons in February, 1931. Production included 75,400 tons of hematite, 120,000 tons of basic, 105,600 tons of foundry, and 10,600 tons of forge pig iron. In the steel department the position was slightly more favourable. The output of steel ingots and castings in February showed an improvement on the preceding month, the respective tonnages being 480,600 and 429,700. The production last month was, however, nearly 6000 tons behind the output for the corresponding month last year.

Steel.

Demand for finished steel continues insufficient to ensure continuous operations at the local rolling mills. The dearth of contracts in the constructional engineering yards results in the buying of material on a hand-to-mouth basis. The steel works are getting small specifications, but the situation is no better than in previous weeks. Selling prices of finished steel are as fixed by the Association. They are strictly adhered to. Most of the Midland constructional engineers are pledged under the rebate scheme to confine their purchases to British steel; consequently, foreign competition does not seriously affect the position. There is a decline in the call for boiler plates, values of which now stand at £8 12s. 6d. per ton. Increased foreign competition is the feature of the half products section of the steel trade. Native makers of billets and bars stand firmly by recent quotations, but Continental competitors have reduced their prices. Foreign billets, which, a fortnight ago, were £4 15s., are now offered at £4 7s. to £4 8s. delivered Birmingham. Merchants are dissatisfied with the response. There has been practically no reopening of negotiations for supplies, many of the works in this district having sufficient foreign steel to satisfy their requirements for many weeks ahead. Pressure is being brought to bear upon Staffordshire re-rollers for easier buying terms. Consumers are said to be offering business at half-a-crown per ton below accepted prices, but, as far as can be ascertained, rollers refuse business at under £6 10s. per ton for bars re-rolled from imported billets. All-British bars are maintained at £7 5s. per ton. There is no change worthy of note in the steel scrap market.

Pig Iron.

There is no improvement to record in the Midland pig iron industry. The rate of consumption continues slow, and blast-furnacemen are unable to secure sufficient specifications to take up current output. While the market for foundry grade iron is slow, that for forge material is practically negligible. Pig iron prices are unchanged, Northamptonshire No. 3 foundry material costs £3 2s. 6d., and Derbyshire and North Staffordshire foundry £3 0s. Forge iron sells at 5s. per ton less in each instance. There is, of course, a rebate available to buyers taking heavy tonnages. Smelters have little hope of reducing their considerable stocks until business improves. While there are prospects of a revival of buying on behalf of the light castings trade in the near future, the same cannot be said concerning the heavy foundries.

Finished Iron.

There is but a small demand for finished iron, and Staffordshire ironmasters—except in a very few favoured establishments—have much difficulty in keeping the mills at work. Hand-to-mouth buying is the rule in all departments, the tube strip branch proving no exception. Quotations are as a week ago. Belgian No. 3 bars, used in nut and bolt and fencing manufacture in this district, are now offered at £5 5s., but there is no demand. The position in the Staffordshire manufactured iron trade gives cause for much concern, and unless there is a revival in demand in the near future the situation will become serious.

Galvanised Sheets.

The galvanised sheet market remains unaltered on the week. Demand is fitful and unsatisfactory, but every effort is being made to stabilise prices on the basis of £9 10s. per ton for 24-gauge corrugated sheets. It is questionable, however, whether rollers are able to get this figure for all overseas business.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinery Exports Still Improving.

THE experience of two months is, of course, no safe criterion, but a certain amount of encouragement among Lancashire engineers is being derived from the fact that, following upon the improvement registered in the opening month of the year, shipments of textile

machinery continue to register an expansion compared with a year ago, exports during February being rather more than £100,000 above the value in the corresponding month of 1931. With the exception of France, Germany, and China, all the markets this year have contributed to the improved trade. The brighter outlook in India, indicated last month at the annual meeting of Mather and Platt, Ltd., is reflected in the appreciably better exports to that country, whose takings represent almost exactly 33 per cent. of the entire British export trade in textile machinery during January and February. Last month's total of 5175 tons, valued at £439,992, included 3335 tons of spinning and twisting machinery, valued at £292,849, and 1404 tons of weaving machinery, valued at £93,949, and compares with a total of 3281 tons and £337,355 a year ago. The exports to India during the month under review reached a total value of £152,318. Japan was the next largest market with £37,957, followed by China £30,181, France £20,421, the Netherlands £19,262, South America £14,650, Russia £14,244, Germany £14,225, the United States £8672, and Australia £7364. In the aggregate, shipments to "other European countries" during February were valued at £99,366, compared with £65,389 a year ago.

Industrial Results.

Net profits of Lancashire Dynamo and Crypto, Ltd., Trafford Park, Manchester, for the year ended December 31st last, were £5391, the distribution on the ordinary share capital being reduced from 2½ per cent. in 1930 to 1½ per cent. The title of the company was changed to its present form as from January 1st last on amalgamation with the Crypto Electrical Company, Ltd., which it previously controlled, the company being formerly known as the Lancashire Dynamo and Motor Company, Ltd. The report of the directors states that the trade depression continued to affect the industry throughout the year, and, as shown by the volume and prices of orders placed, was even more acute than during the preceding period. The profit statement of British Insulated Cables, Ltd., Prescot, is not available at the moment of writing, but satisfactory results are indicated by the fact that, for the third year in succession, a dividend of 15 per cent. is to be paid on the ordinary shares. No dividend is to be paid on the preference shares of Platt Brothers and Co (Holdings) Ltd., Oldham, the dividend being in arrear as from April, 1930. The company is one of the six constituent firms embraced by Textile Machinery Makers, Ltd., a Lancashire combine which started active operations last year.

Business Notice.

It is officially announced by the directors of the Renold and Coventry Chain Company, Ltd., that, as the result of experience gained in operating the several companies associated by the merger, and with a view to further economy and effectiveness of working, it is expedient for the company, which already owns the whole of the shares of the two companies, to take over as from March 14th the whole of the undertakings and assets of Hans Renold, Ltd., Manchester, and of the Coventry Chain Company, Ltd., Coventry, including the right to carry on such businesses in its own name in succession to those companies.

Manchester Steam Users.

Mr. J. Browne, a director and chief mining engineer of Manchester Collieries, Ltd., who has been Vice-president of the Manchester Steam Users' Association for twelve years, has succeeded Mr. Harold Lee as President of the Association, Mr. Lee having just retired after having held office for fifteen years.

Non-ferrous Metals.

All sections of the non-ferrous metals market during the past week have weakened, with the heaviest decline in tin. To some extent, the fall has been due to the higher value of the pound, though this factor does not account for the whole of the weakness. In the case of one or two metals, the lower rates have brought out a good deal more buying interest, but only part of this has been from users. More trade buying has been reported in respect of tin, which, compared with a week ago, is lower by about £5 per ton, current values at the time of writing being cheaper than at any time since the beginning of November. Copper users here have displayed only moderate interest, prices being about 10s. a ton down on balance. Uncertainty as to the future of this metal is as marked as ever. Lead has lost all the ground gained in the previous week, the loss compared with a week ago being about 15s. per ton. Here, also, consuming interests are operating only on a relatively small scale. A decline of about 7s. 6d. per ton in the case of spelter has brought prices in this section down to extremely low levels. Although the spelter-using industries are unsatisfactorily situated, buying interest in the metal at round current values has been on a somewhat bigger scale.

Iron and Steel.

A rather brighter view of prospects is being taken in the iron and steel markets here. Foundry iron buying has not yet got back to what it should be even under present conditions, but the movement has been better than previously this year, forward interest being rather more active. Quotations are at 67s. per ton, delivered equal to Manchester, for Derbyshire, Staffordshire, and Cleveland iron, 65s. 6d. for Northamptonshire, from 86s. 6d. to 87s. for Scottish, and 81s. for West Coast hematite. In manufactured iron, however, there has been no indication of improvement, with the nut and bolt qualities in particularly quiet demand. Lancashire best bars are at £10 5s. per ton and Crown quality material at £9 15s. Steel buying from virtually every direction in this part of the country, including structural firms, is at a low ebb, with orders almost entirely for early delivery. Boiler plates are on the easy side at about £8 12s. 6d. per ton for acid and basic sorts, but other steel products are maintained at about £7 for small re-rolled bars, £8 15s. for joists, £8 7s. 6d. for sections, £8 17s. 6d. for ship and tank plates, and £9 7s. 6d. for 3in. and upward bars. A somewhat better call for iron and steel forgings has been reported here during the past week. This is regarded as satisfactory as reflecting some degree of improvement among general engineering firms.

BARROW-IN-FURNESS.

Hematite.

Despite certain reports to the effect that there is an improvement in the hematite pig iron trade in this district, there is no evidence in the amount of business which is being done. Makers continue to receive small orders for immediate requirements, and as far as Barrow and Ulverston are concerned, all deliveries are from stock, as neither is producing at present. The general state of trade is thin, and there are no convincing signs of an improvement as yet. The Continent has taken some small tonnages, but the total dispatch is much less than some months ago. America, despite rumours of orders and talk of inquiries, has not come in yet with its orders, although in the case of the States as soon as trade improves there will be a demand for West Coast hematite. There is some talk of a little more activity in the way of production and of a change of method at one works, but there is nothing definite to report on the matter at present. Naturally the iron ore trade is very quiet, both as regards native sorts and foreign imports. In the steel trade there is not much activity. The L.M.S. has placed an order for rails, which will be shared by several mills in the country.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Situation.

CERTAIN sections of the local steel industry show an improvement in trade, but the general situation is unaltered, a state of depression continuing. There has been a larger production recently of cold-rolled steel strip and drawn bars, the exchange position and reduced foreign competition having diverted much business of this kind from the Continent to Sheffield. Other departments, notably those producing railway materials, axles, tires, and springs, are, however, poorly employed. The United Steel Companies have six furnaces operating at Templeborough and two at Rotherham. At Parkgate the furnaces are well employed, but the mills are being worked below capacity. Owing to lack of orders, the Renishaw Coal and Iron Company has closed down the furnaces which it re-lit about four months ago.

Lincolnshire Activity.

There has been considerable improvement in trade in the Lincolnshire steel-producing area. Two large open-hearth furnaces at the Frodingham works, which have been idle for months, have been gassed, and a sixth furnace is to be put into operation at the Normanby Park works. There is increased production also at the Appleby works. But despite an urgent appeal made by a local society, the Redbourn Iron and Steel Works at Scunthorpe, of R. Thomas and Co., Ltd., are not to be re-opened. It was hoped to obtain work again for 1000 or more Scunthorpe men, but the firm's directors state that whilst they will reopen the Redbourn works at the earliest possible moment, they regret that it is impossible so long as Continental steel is available at below production costs at Redbourn. They added that the 10 per cent. protection recently granted had not improved the prospects.

Output Statistics.

Interesting comparisons can be made in the latest figures of steel production. During January steel ingots and castings made in the Sheffield district amounted to 62,300 tons, compared with 63,200 tons in December and 65,100 tons in January last year. The total for January this year includes 19,600 tons of acid steel and 37,800 tons of basic steel. In Lincolnshire the January total of 31,400 tons was the same quantity as in December, but 6000 tons less than in January, 1931. In view of the fact that cold rolled steel strip is largely a Sheffield production, it is satisfactory to notice that the output in this country last year was 50,000 tons, which is not far short of the highest outputs of previous years. On the other hand, production of railway tires, wheels, and axles was at its lowest, the year's output being 33,100 tons, compared with 59,000 tons in 1930 and 81,000 tons in 1929.

New Products of Munition Works.

At workshops which during the war were used for the production of munitions, the firm of Sheffield Steel Products, Ltd., Templeborough, Sheffield, is executing orders for hundreds of thousands of small trowels, pincers, and pliers. The firm is also making a large number of special sponge cake trays, of a type which has previously been imported. A technical research department of the firm investigates the possibilities of manufacturing popular articles, the policy of the company being to make goods which hitherto have been produced on the Continent. Vacuum cleaners and automatic selling machines have been made in large numbers during the last few years. The result is the provision of considerable employment, and there is a prospect of further hands being engaged in the near future.

The Lighter Trades.

Several local firms have just installed ingenious machinery for the manufacture of spoons and forks in large quantities. These plants have caused considerable displacement of manual labour, as they perform automatically operations hitherto done by men and women. Substantial savings in costs are effected. Trade in cutlery and in silver plate is very poor, and there has been no noticeable improvement in consequence of Easter demands. It is stated that a new process for producing non-tarnishing silver and silver plate is being tested in Sheffield and adopted by several firms. This process involves the electro-deposition of chromium. The local tool trade is patchy, but there are increases in output, particularly in the cheaper goods which can compete with the German products.

Gas Furnace Experiment.

Although the wrought iron trade is depressed, the Midland Iron Company, Ltd., of Rotherham, is maintaining modern methods of production, and has just installed gas in one of its furnaces. The alterations of the existing furnace to allow the use of gas have been designed and carried out by the firm's staff, and so far as the particular trade is concerned, it is believed that this furnace is the only one of its kind in the country to be fired by high-grade gas. The innovation is still at an experimental stage, but satisfactory tests have been made in regard to output and economies in coal, castings, labour, &c. The experiments are being continued with the assistance of the manager of the Rotherham Corporation gas department.

Attracting New Trades.

With a view to attracting new industries to the city, the Sheffield Industrial Development Committee has issued a booklet describing the local advantages as regards works and sites, and also as regards firms which wish to have manufactured, under licence, goods which they have previously sent into this country from abroad. A register of properties available for disposal has been compiled, and a second register contains the names of about ninety Sheffield firms prepared to manufacture goods under licence. There have been many inquiries for sites for new works and with regard to the manufacture of goods under licence. Similar work is being done at Rotherham, and it is hoped that at least two German firms will start works in that district. One of these firms makes micrometers and precision tools of high quality, and with a capital of £5000 it would be able to open a factory to employ about fifty men at the start. The other wants an English firm, which could make refrigerators, to co-operate in laying down a £60,000 factory, which, after the first six months, when production would be small, would give employment to some hundreds of local persons.

Doncaster Developments.

Important industrial developments are expected at Doncaster, in the north-west portion of the borough which has received special attention from the Corporation for some years. It is being made possible for sites in this area, suitable for works, to have a frontage to the Sheffield and South Yorkshire Navigation Company's Canal, to a railway trunk siding, and to a road 50ft. in width, which will adjoin the railway. Improved wharf and warehouse accommodation is to be provided by the canal company—if the scheme as a whole is sanctioned—and the line of the canal will be straightened out. In addition, railway facilities have been brought across the river by means of a bridge and trunk siding, thus providing for extension into the area to be developed. One Continental firm has already decided to establish a factory here, and there are prospects of other firms following suit.

NORTH OF ENGLAND.

(From our own Correspondent.)

Improved Market Tone.

THERE is much less apathy in the iron and steel trades of the North of England, and the rather better feeling which has been prevalent of late has resulted this week in an improved market tone. Business certainly develops slowly, but an atmosphere of hopefulness is spreading. Continental competition is not so keen, and, not only has the flood of imported material into this district been checked, but some progress has been recorded in the recovery of overseas trade. The rise in the pound increases the cost of British materials to buyers abroad, but it has served to stimulate purchases, and, in fact, seems to have given a slight impetus to sales. Most of the overseas business is for small tonnages, but inquiries are more numerous.

Cleveland Iron Trade.

Rather more buying is taking place in the Cleveland pig iron trade. Orders continue small, however, and makers have no difficulty in giving early deliveries, though stocks are being gradually reduced. There does not appear to be any immediate prospect of idle blast-furnaces being put into work in this district. Very large imports of Indian iron are still going into Scotland, and sales of Cleveland iron to consumers across the Border are difficult to arrange. A few small parcels have been sold this week to consumers on the Continent, and prospects of heavier sales in the near future are distinctly better. Prices are firmly maintained, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

There is just a little better demand for East Coast hematite pig iron, and the price of mixed numbers is, if anything, a shade firmer, but supplies are still obtainable at 63s. 6d. No. 1 quality is put at 64s. Producers are reluctant to sell at these unremunerative rates, but merchants readily accept the figures named.

Ironmaking Materials.

No business is possible in foreign ore; indeed, deliveries are heavily in arrears, but 16s. is indicated as a figure which would be accepted for best Rubio c.i.f. Tees. Good medium blast-furnace coke is still offered at 16s. 6d. delivered at the works.

Manufactured Iron and Steel.

In the steel trade it is noteworthy that the output for the short month of February was the highest since March of last year. The mills are still slack, but there is

more inquiry for heavy constructional steel, and prospects are held out of some big orders. Shipbuilding work is scarce, but there is more life in the sheet trade. Prices are unaltered.

A Train Ferry.

Swan, Hunter and Wigham Richardson, Ltd., of Newcastle, have obtained an order for a train ferry steamer for service between Nanking and Pukow, China. The ship and engines will be built at the Neptune Works, Walker, and will be constructed under the supervision of Sir John H. Biles and Co., London. Although the ship is not a very large one, the order is particularly welcome under existing conditions. The position in the ship-repairing industry of the North-East Coast is practically unchanged. A number of vessels have been completed and others have arrived in their place. Most of the work required, however, continues to be of a minor character and quick dispatch is being given. There is a prospect of work on vessels which are to undergo machinery improvements.

The Coal Trade.

The general outlook in the Northern coal trade is a little more encouraging than it has been for some week past. Quite a number of foreign inquiries are circulating for deliveries up to the end of July, and a cheering bit of news is that another cargo of Durham coal has been sold to Newfoundland, and also one to Canada. More orders from the same region are likely to be secured. With Easter near, the prompt coal position is firming up, and loading turns are more satisfactory. There is a good demand for Northumberland steam coal, and tonnage has been stemmed in larger volume to load during this month. Best steams are unchanged, but firm at 13s. 6d. Output is being steadily booked up, and the undertone tends firmer. Second steams are quoted at 12s. to 12s. 6d., and small at 8s. 6d. Prime Wear large steams are firm at 15s., and small at 12s., while Tyne prime large are steady at 13s., with small firm at 9s. The position for Durham gas coal is still disappointing for this month's delivery. Supply is plentiful and prices remain easy. Best gas coal is at 13s. 6d., and prime Wear qualities at 15s. Durham coking unscreened is also easy at 13s. to 13s. 6d., and coking small at 12s. 6d. to 13s 3d. A brisk demand is in evidence for best grade bunker coal. Many boats are proceeding to long-distance ports in ballast, and are consequently taking large supplies of bunker coal. The output is well taken up, and sellers quote firmly for best at 13s. 6d. to 14s., and steady for ordinary at 13s. 3d. There is not much moving in the coke department. Inquiries are slow, and all makes offer in excess of requirements. Best gas coke stocks are slowly increasing, but producers hold firm to 19s. Other makes are fairly plentiful at 18s. 3d. to 18s. 6d. Patent oven coke is readily obtained at 16s., and superior makes at 18s. to 20s. The demand for coke nuts has fallen off, and prices are nominal at 19s. to 19s. 6d.

SCOTLAND.

(From our own Correspondent.)

Steel.

THERE is no appreciable change in the steel trade. Inquiries perhaps are a shade better, but there is comparatively little movement in any department. Shipbuilders and other consumers have practically nothing in the way of fresh contracts, and specifications for all classes of materials are exceedingly scarce. Apart from repair works, the shipyards are almost devoid of work, and without any indication of new business. Heavy steel remains extremely quiet. Plate and section mills are poorly employed, only about 30 per cent. of the plants being in operation. Prices are unchanged.

Steel Sheets.

Sheet makers have a fairly steady demand for light gauges, but heavy descriptions are short of specifications. Prices are firm at £7 15s. for 10 gauge, home and export. Galvanised flat and corrugated sheets are dull at present on both home and export account. Prices are round about £10 15s. home and £10 per ton export for 24 gauge.

Iron.

Most of the bar iron works are in operation, but outputs continue on a restricted basis, business in all qualities being exceedingly scarce. Re-rolled steel bars have had a slightly better turnover, but the volume of business is most unsatisfactory. Prices continue round about £6 5s. home and £6 2s. 6d. per ton export.

Pig Iron.

There are still only six pig iron furnaces in blast in Scotland, but supplies are ample, the demand being extremely light. During the past week 4300 tons of pig iron arrived in the district from Calcutta, and about 400 tons from Workington were discharged at Bowling. Prices are unchanged.

Scrap.

The market for scrap is flat, and though prices show no change the tendency is easier. Cast iron machinery is quoted 52s. 6d. to 55s. and heavy steel 40s. to 42s. 6d. per ton.

Coal.

There has been no change of importance in the Scottish coal market during the past week. Home demands are, if anything, just a shade better, but the shipping department shows little sign of expansion. Prices generally show no change, but supplies of all classes of fuel are ample, and a slightly easier tendency is noticeable, apart perhaps from Lanarkshire prime splints and best ells. Washed materials have been irregular, with Fifeshire trebles the strongest feature. Aggregate shipments amounted to 212,165 tons, against 244,784 tons in the preceding week and 180,858 tons in the same week last year. It is gratifying to note that of the 113,000 tons of fuel contracted for by the Swedish State Railways for April–June delivery, the amount allotted to Scotland is 25,000 tons of Cowden-beath-Lochgelly-Glencraig coal. Another interesting item is the announcement of a contract secured by a firm of merchants to supply 100,000 tons of Ayrshire washed nuts and pearls during the ensuing twelve months to the Electricity Department of the Liverpool Corporation. It is said that the contract was arranged on the basis of 10s. 6d. for singles and 9s. 6d. per ton pearls, which are the official minima for coastwise business.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE approach of the Easter holidays has not brought forth new business in steam coals to any material extent. It is true that arrangements have been made to expedite the shipment of orders held, but this has not made collieries much busier. Figures issued by the Great Western Railway Company relating to shipments of all qualities of coal and coke from the ports under its control show that the total last week was 457,300 tons, as compared with 437,010 tons for the preceding week. This improvement was not unexpected in view of the fact that the number of vacant loading berths showed a lower level almost throughout the whole of the week than had been experienced for some time; but it is questionable whether the figures for the current week will turn out to be quite so good. The returns for Monday last showed that there were thirty vacant loading berths, and on Tuesday the position was even less favourable, which indicates pretty plainly that most collieries are having rather a lean time and that there is no pressure of new orders for prompt execution. Business is unquestionably very quiet, and last week's appreciation of the pound has not helped the situation, while financial conditions prevailing abroad are not helpful to an expansion of trading operations. There are a few inquiries about for supplies of coal to be delivered over a period, but prompt orders are very scarce. In the case of the inquiry for 75,000 tons of steam coals for the Brazilian Central Railways, nothing so far has come of the business, and it is quite on the cards that the order, or the bulk of it, will go to German sellers. This is a case where the question of the terms of payment is very important, particularly as firms which have exported coals to Brazil for the past two years have not yet been paid, and, obviously, they cannot continue sending out supplies without getting payment. Unfortunately, the position is not assisted by the fact that further political unrest is manifesting itself in Brazil.

Welsh Coal Output.

When the annual meeting of the Monmouthshire and South Wales Coalowners' Association was held at Cardiff on Monday, the secretary gave particulars of production for 1930 and 1931. They were as follows:—

District.	1930. Tons.	1931. Tons.	Decrease, per cent.
Cardiff ..	23,842,407 ..	19,253,367 ..	17·33
Newport ..	12,518,639 ..	10,340,488 ..	17·40
Swansea ..	6,809,270 ..	6,223,362 ..	7·79
Total ..	43,170,316 ..	35,817,217 ..	15·84

Mr. W. D. Woolley was elected the new chairman, and Mr. F. Llewellin Jacob vice-chairman for the ensuing year. Mr. Woolley recalled that the Association was formed sixty-eight years ago. The number of members was originally eleven colliery companies, whose output was 1,623,000 tons. Now, there were seventy-five colliery companies in the membership, with an assured output of 37,000,000 tons, which compared with 53,000,000 tons in 1924.

Control of Coal-trimmers.

The result of the ballot of the coal-trimmers at Cardiff, Penarth and Barry last week on the question of the change in the system of control, viz., by the Employers' Clearing House, instead of through joint control by the Coal Trimming Board, turned out to be very much as expected. There were 859 for acceptance of the employers' proposals, and 499 against, a majority of 370. A meeting of the Joint Control Board was held on Monday, when the men's representatives formally reported the result of the ballot, and a new agreement was signed, it being agreed that the Employers' Clearing House should take over control of the coal-trimming work as from the evening of March 30th. The Joint Board will continue to function as a Conciliation Board to deal with disputes, &c. At Newport the trimmers, in addition to accepting the employers' proposals concerning the question of control, have abandoned the system of pooling earnings. As from the 21st inst., the men will be paid exactly what they earn, but no departure is to be made from the condition and rates of employment as laid down by the national trimming arrangements. About two-thirds of the trimmers will be made up into gangs and the remaining men will be retained as extra men and used from day to day, generally on the larger vessels.

North Wales Coalfield.

The report of the independent accountants reveals that the working of the North Wales coalfield showed a credit balance in January of £2474, equal to 2·23d. per ton, compared with a credit balance in December of £1681, equal to 1·49d. per ton. The proceeds for the month on an output of 266,631 tons were £170,775, or 12s. 9·72d. per ton, and costs of production £168,301, or 12s. 7·49d. per ton. Wages absorbed £117,863, and other costs £50,438. The wage certified in accordance with the provisions in the agreement regulating the distribution of the proceeds was 2·17 per cent. above the basis rates, but the agreement provides for a minimum wage of 22 per cent. above the basis rates, and the deficiency arising from the payment of this minimum was £67,268, thus increasing the deficiency carried forward to £4,641,208.

Current Business.

The tone of the steam coal market continues without change, and is very quiet in practically all departments. Dry coals are relatively steadier than other sections, though sized coals meet with a fair inquiry. Prices all round are practically stationary at the minima. With regard to banked smalls, it will be recalled that last November the Executive Board of the South Wales Coal Marketing Association made new classes of banked, smalls and allowed their sale at 2s. below the equivalent of fresh wrought coals, but banked smalls could not be exported to France unless they were not subject to licence. The Board has now decided that the reduction of 2s. per ton shall not apply to shipments to France, and any banked smalls or duff sold to that market must be at not less than the appropriate minimum price for fresh wrought coals. Coke and patent fuel are unaltered and quiet in demand, while pitwood is quoted at prices ranging from 20s. 6d. to 22s. 6d.

LAUNCHES AND TRIAL TRIPS.

ROYAL EAGLE, paddle steamer; built by Cammell, Laird and Co., Ltd.; to the order of General Steam Navigation Company, Ltd.; dimensions, 289ft. 9in. by 36ft. 6in. by 11ft. 6in.; to carry passengers. Engines, triple-expansion; constructed by the builders; launch, February 24th.

TILBURY II., bucket dredger; built by Ferguson Brothers (Port-Glasgow), Ltd., to the order of the Port of London Authority. The dredger was launched complete with steam up, March 3rd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

PAULING AND CO., Ltd., of 26, Victoria-street, S.W. 1, ask us to announce that Mr. Thomas William Thompson, B.A., M. Inst. C.E., has been elected a director of the company.

GLENFIELD AND KENNEDY, Ltd., inform us that, on and after April 1st, 1932, their London offices will be removed to Victoria Station House, Victoria-street, S.W. 1. Telegraphic address, "Meterage, Phone, London;" telephone number, Victoria 0209.—On and after the same date the London offices of the British Pitometer Company, Ltd., will be removed to the same address. Telegrams, "Bripitco, Sowest, London;" telephone, Victoria 0209.

SINCE 1925, Medway's Safety Lift Company, Ltd., has been controlled by J. and E. Hall, Ltd., of Dartford, Kent, and the design and manufacture of the Medway Company's lifts has been carried out at Messrs. Hall's works. In December last the assets and outstanding contracts of the Medway Company were taken over by J. and E. Hall, Ltd., which is continuing the business as a department of its organisation, with the whole of the *personnel* formerly employed by the lift company. The change involves no more than a limited amount of internal reorganisation. In addition to lifts of all types, J. and E. Hall, Ltd., are now manufacturing escalators to the design of the Carl Flohr Company, of Berlin. Five of these equipments have recently been installed at Messrs. Bentall's new store at Kingston-on-Thames, and another escalator order has been received from Messrs. Hammonds, of Hull.

CATALOGUES.

RATEAU, 28, Russell-square, W.C. 1.—Catalogue 53 on compressed air driven fans.

CROFTS (ENGINEERS), Ltd., Thornbury, Bradford.—Catalogue of light power geared motors.

HADFIELDS, Ltd., East Hecla Works, Sheffield.—Pamphlet 333 on a three-stage coal breaker.

WM. ASQUITH, Ltd., Halifax.—No. 1 of the *Radial Times*, the firm's new bi-monthly journal.

ROBERT BOBY, Ltd., Bury St. Edmunds.—Leaflets on the "Varyshaker" grain and seed-cleaning machine.

BRITISH PISTON RING COMPANY, Ltd., Holbrook-lane, Coventry.—A booklet on "Brico" alloy cast iron.

AUSTIN AND CO., Dunn-street, Newcastle-on-Tyne.—A loose-leaf catalogue of lifts of all types and for all purposes.

R. WHITE AND SONS, Widnes, Lancs.—A small booklet dealing with specialities in railway work and aerial wire ropeways.

BELLISS AND MORCOM, Ltd., Ledsam-street Works, Birmingham.—Pamphlet on "Bellis" airless injection Diesel engines.

A. C. WICKMAN, Ltd., Coventry.—Booklet giving the history and development of "Widia" brand tungsten carbide cutting tools.

RUSTON AND HORNSBY, Ltd., Lincoln.—A thirty-page publication describing in some detail the Ruston oil engine and its work.

BRITISH BELTING AND ASBESTOS, Ltd., 59, Southwark-street, S.E. 1.—"Friction Fabrics: Their Application to the Automobile."

G. AND J. WEIR, Ltd., Cathcart, Glasgow.—Publication No. 34 on calorifiers for the supply of hot water for heating systems and general service.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester.—A leaflet on A.C. and D.C. fractional horse-power motors.

PETTERS, Ltd., Yeovil.—"Two-stroke or Four-stroke Cycle: A Word to Intending Purchasers of Heavy Oil Engines for Industrial and Marine Purposes."

CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., 170, Piccadilly, W. 1.—The following new publications:—S.P. 166, L.G. Pneumatic Drill Equipped with Air Feed Cylinder; S.P. 167, C P Portable Pneumatic Yoke Riveter; S.P. 171, No. 1 Pneumatic Vibrator; S.P. 172, Rotary Drills; S.P. 173, Pneumatic Grout Injector; S.P. 174, Three Aids to Economy; S.P. 175, C P Portable Haulage Gears; S.P. 176, Small Pneumatic Yoke Riveters.

ERRATUM.—Page 280, March 11th, 1932, second column, 37th to 40th lines. After "Sir Holberry Mensforth, . . . general manager of works, Metropolitan-Vickers Electrical Company," read "1917 to 1920."

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/-
(1) Spanish	17/- to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 3 6	3 3 6
No. 1	3 4 0	3 4 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
" " Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*)	—
	4 0 6 (*b*)	—
	4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
" " (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.	10 15 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
" " (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
" (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
" (Lancs. Boiler)	8 12 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 5 0 to 7 15 0	—
Small Re-rolled Bars	6 12 6 to 6 15 0	—
Billets and Sheet Bars	5 7 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 10 0	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	16/-
Block Tin (cash)	128 0 0
" (three months)	129 15 0
Copper (cash)	33 6 3
" (three months)	33 5 0
Spanish Lead (cash)	12 6 3
" " (three months)	12 15 0
Spelter (cash)	12 10 0
" (three months)	13 0 0
MANCHESTER—	
Copper, Best Selected Ingots	37 5 0
" Electrolytic	38 10 0
" Strong Sheets	66 0 0
" Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9½
" Condenser, lb.	0 0 11½
Lead, English	14 12 6
" Foreign	12 12 6
Spelter	13 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£26 8 6	7/-
" " 6 p.c. to 8 p.c.	£23 10 0	7/-
" " 8 p.c. to 10 p.c.	£23 0 0	6/6
" " Specially Refined		
" " Max. 2 p.c. carbon	£40 0 0	10/-
" " " 1 p.c. carbon	£55 0 0	12 -
" " " 0·70 p.c. carbon	£57 10 0	13/-
" " " carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
" " "	£11 10 0 for export	
" Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
" " 75 p.c.	£17 15 0 scale 7/- per unit	
" Vanadium	12/9 per lb.	
" Molybdenum	6/3 per lb.	
" Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	10/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/- to 13/3
" " Ell	14/3
" " Splint	14/- to 16/-
" " Trebles	12/6
" " Doubles	10/9
" " Singles	9/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/-
" " Jewel	16/6
" " Trebles	12/6
FIFESHIRE—	
(f.o.b. Methil or Burnt island)—Steam	11/6 to 12/6
Screened Navigation	16/6
Trebles	12/6 to 13/6
Doubles	10/6
Singles	9/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/9 to 12/-
Secondary Steam	11/6
Trebles	11/6 to 12/-
Doubles	10/6
Singles	9/6

(8) N.W. COAST— ENGLAND.

Steams	21/9
Household	32/6 to 51/3
Coke	20/6 to 23/-
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	26/6 to 27/6	—
South Yorkshire Best	22/- to 23/-	—
Derbyshire Best Bright House	22/- to 23/-	—
Screened House Coal	19/- to 20/6	—
Best Screened Nuts	17/- to 18/-	—
Small Screened Nuts	14/6 to 15/6	—
Yorkshire Hards	16/- to 18/-	—
Derbyshire Hards	16/- to 18/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/- to 8/6	—
Smalls	5/- to 6/-	—

Blast-furnace Coke (Inland) 12/- to 12/6 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 18/- to 18/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 25/-
No. 3 Rhondda Large	19/6 to 19/9
" " Smalls	15/- to 16/-
No. 2 " Large	17/- to 17/3
" " Through	15/6 to 16/-
" " Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 26/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	19/- to 19/3
Pitwood (ex ship)	20/- to 22/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/- to 43/6
Beans	28/6 to 32/6
Peas	18/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/3 to 8/9
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate ; Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Shipbuilding.

In view of the failure of French shipbuilders to secure orders for warships from foreign Governments in competition with builders in some other countries where the facilities for construction can hardly be better than they are in France, a decree has been published suppressing import duties on all machinery and material brought into the country for the building of such ships, and also relieving builders of the tax on turnover. This will mean an appreciable economy in the construction of warships for foreign Governments, and will doubtless favour British makers in the supply of ship plates and other material. At the same time, shipbuilders are looking to the Government to enable them to extricate themselves from a situation which, if allowed to continue, can only, it is declared, end in disaster. Not a single order appears to have been received for more than six months. While the sixteen yards are idle, the launching of the "El Kantara" on the Tyne for the Compagnie de Navigation Mixte, which will put it in service between Port Vendres and Algiers, and the delivery of a motor cargo boat from Copenhagen, have intensified the agitation for some measures to ensure that all orders are kept for home shipyards. This agitation is intended to influence the Government in the preparation of the plan for giving aid and protection to the shipbuilding industry. There was some fear that the suppression of the Ministry of the Merchant Marine, and the transfer of its duties to the Ministry of Public Works, would have caused further delay in completing the scheme. Shipbuilders are now hoping that the change will be to their advantage. The proposal to meet the situation by suppressing some of the yards is rejected by Monsieur René Fould, President of the Chambre Syndicale des Constructeurs de Navires et des Machines Marines, on the ground that when the crisis is over the requirements of the French merchant marine will be something like 175,000 tons a year, which will provide ample work for all the builders. On the other hand, there are others who believe that the crisis is to be ascribed to permanent factors, and that the only remedy lies in an international arrangement for adjusting the tonnage to the needs of seaborne traffic.

Railway Wagon Builders' Cartel.

The withdrawal of German wagon builders from the International Association of Railway Rolling Stock Manufacturers on the ground that some members of the Cartel had failed to conform to its conditions, had the effect of suppressing that organisation after it had completed its first period at the end of last year. It has now been reconstructed at a meeting held at Zurich, at which France, Belgium, Italy, Switzerland, Austria, Hungary, and Czechoslovakia, together with Poland, which had previously held aloof from the Cartel, gave their adhesion. While retaining the former system of organisation, the Cartel will no longer tie down its members to hard-and-fast rules, there being simply an undertaking to accept general conditions which may be modified from time to time if it be found necessary to do so, in view of changes in the economic situation. The object is mainly to concentrate the interests of Continental wagon builders and to make an organised effort to secure foreign business. To that end the arrangements for financing the execution of foreign orders will be maintained, and there will be a technical department for dealing with matters of interest to members of the Cartel, particularly in the way of standardising specifications in the hope of getting them accepted by foreign railway companies.

Motor Roads.

The Minister of Public Works has received a deputation from the south-east of France which urged upon him the importance of putting in hand at once a scheme for the construction of a motor car road between Lyons and Evian-les-Bains, whereby employment will be found for 20,000 men for many months to come. The plans are already under consideration by the General Council of Public Works and by the Ponts et Chaussées. They provide for the construction of a road from Lyons to Evian by way of Chambéry, Aix-les-Bains, Annecy, and Thonon. It will be enclosed by barriers on both sides, and will not traverse any town or village, and will avoid railways and cross roads by passing under or over them. It will only be possible to get on to the road through "auto-stations," at which a tax will be paid by each car, the proceeds of which will go towards the cost of construction and maintenance.

Unemployed Engineers.

The Federation of Associations of Engineers, comprising about 55,000 members, is endeavouring to find relief for the considerable number of engineers who are at present without employment or who have been obliged to accept minor jobs that are below their status. A warning is given of what will happen if the ranks of the profession continue to be swollen at the rate of 3000 a year from the schools, colleges, and universities that are turning out specialised engineers far in excess of requirements. The total number of engineers at present is stated to be 60,000. The remedies suggested for the critical situation of the great mass of engineers brought about by the industrial slump do not appear convincing, unless employers see that in times of bad trade they have an interest in keeping engineers at work on the technical organisation of industry. In any case, it is concluded that there are too many engineers, some of whom will probably have to content themselves with working as foremen, and it is a sad commentary on the situation that an attempt should now be made to assimilate engineers with workmen in the receipt of unemployment relief. There are thousands of young men who have undergone an expensive training as specialised engineers, and have nothing to live on apart from their work. On the other hand, the situation is not so bad for engineers trained in the big schools where "culture" is at the base of the teaching, and it is urged that as they possess qualities of order and method and initiative that are appreciated in all occupations, they may find employment outside engineering, which is what many of them have already done.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

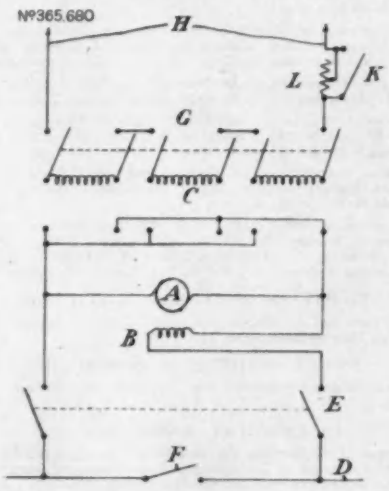
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C.2, at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

365,680. November 3rd, 1930.—CONTROL OF DIRECT-CURRENT ELECTRIC POWER SYSTEMS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; John Alan Jaffrey, of 135, Murray-road, Rugby; and Harold Orchard, of 30, Claremont-road, Rugby.

The system of electric control described in this specification is applicable to ship propulsion systems in which D.C. generators or motors are connected in a series circuit, and the invention relates to the switching into circuit of a generator or motor while power is maintained on the circuit. The machine A has a differential series field winding B and main field winding C. A switch G is adapted to connect the parts of the field winding C alternatively in series across the excitation supply circuit H or in parallel across the armature A, and its purpose is to effect the demagnetisation of the machine. The armature is connected through the switch E into the line D and is arranged to be short-circuited by the switch F. In the excitation supply circuit H a switch K is inserted, shunted by an adjustable resistance L. During the operation of the machine in the circuit D switch F is open, E is closed, K is closed, and the arms of switch G are in their upper position. The armature is thus connected in series with

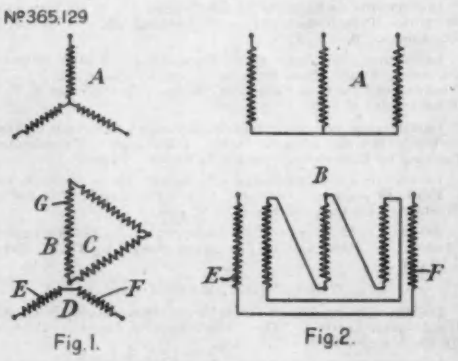


other elements in the line and the main field winding is excited from the supply H. The method of cutting out the machine from the line is first to move the arms of switch G into their lower position. This divides the field winding C into a number of parts and connects the parts in parallel across the armature, which gives the demagnetisation of the main flux. The potential across the contacts of switch F is thus reduced and this switch F is next closed, no burning of the contacts taking place. Finally the machine is isolated by opening the switch E. The machine is inserted in the line by first opening switch K. Switch E is then closed and the arms of G moved to engage their upper contacts. A short circuit is thus produced across the armature A through the switches E and F. The resistance L is then adjusted so that no current passes through the switch F; that is, the armature short-circuit current is arranged to be equal in value and opposite in direction to the current in the line. The differential series winding B allows the required value of current to be obtained in a stable manner. The switch F is next opened and no burning of contacts takes place, as the machine A is already in circuit. The resistance L is then cut out of the excitation circuit by closing switch K, so that normal running conditions are attained.—*January 25th*, 1932.

TRANSFORMERS AND CONVERTERS.

365,129. July 11th, 1930.—TRANSFORMERS, Allmänna Svenska Elektriska Aktiebolaget, of Västeras, Sweden.

The Scott connection for obtaining two-phase currents from a three-phase network has several disadvantages. Some arise from the fact that the magnetic flux is a two-phase one, and this in practice makes the use of two single-phase cores necessary. Theoretically these two cores could be combined into one, the



middle leg of which would have a section which is $\sqrt{2}$ times the section of the other legs, but in standard manufacturing it is generally preferred to employ two separate cores. According to this invention, which utilises a three-phase primary winding and a three-phase flux in a symmetrical three-legged core, one phase of the two-phase secondary winding is placed on one leg of the core and the other phase is divided between the two other legs, while all the legs carry a delta-connected winding serving to equalise the load. In a preferred form this delta-connected winding is combined with the undivided secondary winding or a portion thereof to form a single delta-connected winding, one phase of which is traversed by the resulting current. As an equalising winding the primary winding may also be used when it is delta-connected. Fig. 1 is a diagram of the one form of the invention, drawn in the conventional manner, according to which the windings are placed in the directions of the corresponding voltage vectors. Fig. 2 is a corresponding diagram showing the windings as arranged on three parallel legs in space. The primary winding A is an ordinary Y-connected three-phase winding having an accessible neutral point. The secondary winding B is divided into one portion C connected in delta and one portion D connected in the form of an obtuse V. If the number of turns in each portion E F of the V-connected winding is equal to n, the number of turns in each portion of the winding C should be $n\sqrt{3}$. Further, the portion G of this winding should have a larger section than the other ones, and the reason for this is fully explained.—*January 11th*, 1932.

PUMPING AND BLOWING MACHINERY.

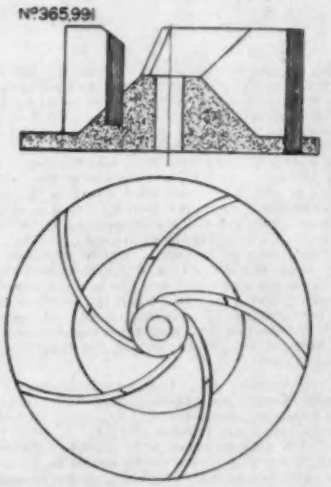
365,817. February 5th, 1931.—CENTRIFUGAL PUMPS, G. H. Humphreys, 17, Victoria-street, Westminster.

In order to provide a centrifugal pump for handling sewage which may contain solid matter that would choke the ordinary

pump, the inventor makes the vanes on the impeller of his pump of rubber. Then, in the event of an obstruction occurring, the vane gives way and the consequent rush of water dislodges the object. The sketch shows the method of fixing the rubber vane on a bulbous rib A with a cover plate B.—*January 28th*, 1932.

365,991. September 1st, 1931.—BLADE WHEELS FOR FANS, International General Electric Company, Inc., 120, Broadway, New York, U.S.A.

This invention is concerned with very fast-running fans, such as those used in vacuum cleaners. The hub and disc are made



in one piece, of pressure-moulded artificial resin, and the blades of stratified layers of woven material impregnated with artificial resin, heated and compressed. The blades are pressed into the hub while it is being moulded, and it is said that it is practically impossible for the joints to become loose.—*January 28th*, 1932.

METALLURGY.

365,895. April 13th, 1931.—HARD ALLOYS, Fried. Krupp Aktiengesellschaft, Essen, Germany.

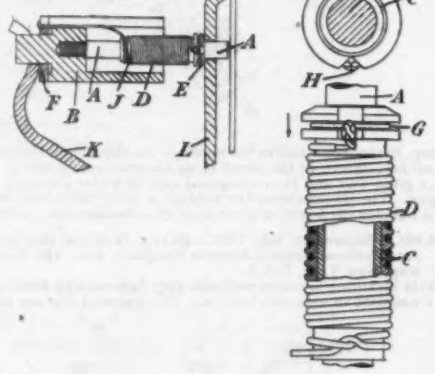
The invention consists in forming a hard alloy by sintering or melting a mixture of titanium carbide and titanium nitride. It is found, the inventors say, that an extraordinarily hard and at the same time very solid product results which is very suitable for the manufacture of tools and working implements of every kind, but especially cutting tools. A special advantage of the new alloy consists in the fact that titanium compounds suitable for the production of titanium carbide and titanium nitride are available in large quantities as constituents of the slag obtained in the operation of blast-furnaces, so that the starting materials of the new alloy can be supplied very conveniently and cheaply. It is found to be particularly advantageous if the titanium carbide and titanium nitride are present in approximately equal quantities in the alloy. An alloy containing about 50 per cent. of titanium carbide and 50 per cent. titanium nitride has a melting point of about 3230 deg. Cent., which is not only higher than that of titanium nitride, about 2950 deg. Cent., and of titanium carbide, about 3140 deg. Cent., but is actually the highest melting point obtainable within the series of possible alloys of titanium carbide and titanium nitride. It is probably this feature which is the cause of the particularly great hardness of an alloy consisting of 50 per cent. of titanium carbide and 50 per cent. of titanium nitride. The new alloy can be produced by melting or by pressing and subsequent sintering or by

simultaneous pressing and sintering of the starting materials in powder form. The toughness of the new alloy can be improved by adding one or more metals, such as cobalt, iron, or nickel, of lower melting point than the carbide and nitride forming the major portion of the alloy, the said metals being added in quantities up to a total of 25 per cent. A suitable example of a method of production of the new alloy is as follows:—A powder mixture composed of 50 per cent. of titanium nitride and 50 per cent. of titanium carbide is taken. Pure titanium nitride can be produced by heating the commercial material for a short time in a tubular carbon furnace at 2000 deg. Cent., while scavenging the furnace with nitrogen, and pure titanium carbide can be produced by heating a mixture of titanium acid and carbon for a short time in a current of hydrogen at 2000 deg. Cent. Pressed bodies are formed of the mixture of the finely powdered materials and are sintered on a carbon bed at 2400 deg. Cent., while being scavenged by nitrogen. Hereupon they acquire a remarkable hardness. By the addition of a metal which it is relatively easy to melt—for instance, by the addition of from 7 to 10 per cent. cobalt—not only can the toughness of the finished alloy be improved, but also the sintering temperature is lowered. Furthermore, the pressed bodies may first be preliminarily sintered at a lower temperature than that necessary for final sintering, and then shaped, since in this condition they can easily be shaped. The great hardness and strength may then be imparted by final sintering.—*January 28th*, 1932.

MISCELLANEOUS.

365,307. January 9th, 1931.—Thermally-acting Electric Protective Devices, Siemens Brothers and Co., Ltd., of Caxton House, Tothill-street, Westminster, S.W. 1, and Christian Rasmus Riber, of "San Remo," 24, Dorville-road, London, S.E. 12.

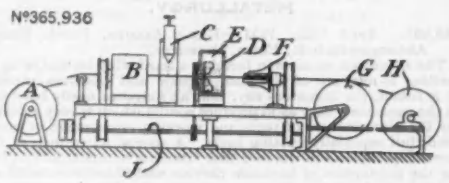
This invention relates to improvements in electric circuit protective devices of the type known as heat coils. Such a device comprises a heating element in the form of a coil of insulated wire wound around a metal cylinder or sleeve surrounding a pin, which is sweated on to the pin by an alloy or metal having a low melting point. The device is held in a spring holder, the members of which make connection to the two ends of the coil respectively, so that the coil is connected into the circuit to be protected. When current flows through the coil in excess of a predetermined strength, the heat produced in the coil is conducted to the metal sleeve and thence to the alloy or metal holding the sleeve and pin together, and causes it to melt, allowing relative motion of the sleeve and pin to take place, owing to the pressure of the spring holder, whereby contact



springs may be operated to divert the current from the normal circuit. A is a metal pin screwed into an insulating casing B, and upon the pin a metal sleeve C is sweated by means of a metal or alloy of low melting point. The wire D of the heating element is wound in a thread in the sleeve, one end of the wire being attached to a head E, whilst the other end is attached to a metal washer F. The head E outside the case is in the form of a collar having a groove G, and the wire of the coil enters this groove by way of a notch, and after a turn in the notch it terminates in the notch where it is held by a spot of solder of high melting point. The end J of the sleeve may be provided with a flange or a flare. The coil is placed in a spring holder, which may consist of two springs K and L, which maintain a pressure tending to cause the sleeve C to slip inward over the pin A, or rather to cause the whole case and pin to slip forward relatively to the sleeve C and spring L. When the metal or alloy melts, owing to heat produced by current in the coil, such motion is permitted, and the pin A then operates contact springs so as to earth, for instance, the circuit carrying the dangerous current.—*January 21st*, 1932.

365,936. November 14th, 1930.—Insulation of Electric Cables, Norah May Loudon and the London Electric Wire Company and Smiths, Ltd., both of 7, Playhouse-yard, Golden-lane, London, E.C. 1.

The object of this invention is to provide a fireproof insulation for electric cables covered with rubber or bitumen or the like. The cable has an inner insulating sheath coated with yarn which has been treated with selenium and an outer sheath of textile material. The invention also relates to a method of producing a fireproof electric cable, which comprises the following steps:—(1) Coating an insulated cable with yarn; (2) treating the yarn coating with selenium; and (3) applying a textile outer covering to the cable. The cable to be treated is drawn from a drum A through a unit B by means of which yarn



is applied, and is thereafter passed under a device C by means of which an inert liquid, for example, a silicate, is applied, for binding purposes. The cable is then caused to travel through a unit D by means of which an admixture of powdered selenium and zinc oxide is applied. The loose mixture of selenium and zinc oxide is agitated by means of a paddle E, so as to create a cloud of material, which thereby settles uniformly upon the cable as it is traversed through the unit D. The cable, after leaving the unit D, travels through a polishing device F, comprising a number of pressure plates which are rotated around the cable to a take-off wheel G, and from thence to a receiving drum H. The yarn applying unit B, the unit D for applying the selenium powder, and the polishing unit are driven by belt and pulley mechanism from a main driving shaft J.—*January 28th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Chemical Engineering Group.—Joint meeting with Birmingham Section, in the Chamber of Commerce Buildings, New-street, Birmingham. "Some Characteristics of Nickel and its Alloys," by Mr. W. R. Barclay. 6.45 p.m.

Illuminating Engineering Society.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. "The Application of Electric Light to Agriculture," by Mr. F. E. Rowling. 6.45 p.m.

Institution of Automobile Engineers.—Joint meeting with the Engineering and Scientific Club, Queen-street, Wolverhampton. "Compression-ignition Engines for Road Transport," by Captain W. Vane Morland. 7.30 p.m.

Institution of Electrical Engineers: Meter and Instrument Section.—Savoy-place, Victoria Embankment, W.C. 2. Discussion:—"Is the British Standard Specification for Meters too Stringent?" to be opened by Mr. G. F. Shotter and Mr. A. W. Barham; "Special Tariff Prepayment Meters," to be opened by Mr. E. Fawssett; "Is the Calibration of Watt-hour Meters with their Transformers Desirable?" to be opened by Mr. A. J. Gibbons and Mr. W. Holmes. 6.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Discussion, "The Machinability of Steel as Indicated by its Macrostructure," by Mr. F. E. Robinson and Mr. C. T. Nesbitt. 6 p.m. Benevolent Fund meeting at 5.30 p.m.

Institution of Naval Architects.—In the Lecture Hall, Royal Society of Arts, John-street, Adelphi, London, W.C. 2, Seventy-third Annual Meeting. For programme see page 270.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal debate on engineering topics. 7.30 p.m.

Physical Society.—Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.; meeting, 5 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Gamma Rays," by Lord Rutherford. 9 p.m.

West of Scotland Iron and Steel Institute.—In the "Societies' Room," No. 24, Royal Technical College, George-street, Glasgow. The Council will meet at 6.45 p.m. "Notes on Autogenous Welding," by Mr. W. E. J. Lewis. 7.15 p.m.

TO-DAY AND SATURDAY, MARCH 19TH.

Institution of Municipal and County Engineers.—Scottish District meeting at Ayr.

TO-DAY TO THURSDAY, MARCH 24TH.

Holland's Industries Fair.—At Utrecht, Holland. Open daily.

SATURDAY, MARCH 19TH.

Institute of British Foundrymen: Lancashire Branch.—In the College of Technology, Sackville-street, Manchester. "Some Notes on Italian Steel Foundry Practice," by Dr. Vanzetti. 4 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Visit to Dunston Power Station. 2.30 p.m.

Institution of Municipal and County Engineers.—Yorkshire District meeting at Shipley. Meet at the Council Offices, Somerset House, Otley-road, Shipley, 2.30 p.m.

Keighley Association of Engineers.—Queen's Hotel, Keighley. Annual Dinner; reception, 5.45 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. "The Electron," Lecture II., by Lord Rutherford. 3 p.m.

MONDAY, MARCH 21ST.

Institution of Automobile Engineers.—At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Motor Cycle Progress: Past, Present, and Future," by Captain H. D. Tenge. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Graduates' Section. Discussions: "Ball and Roller Bearings," by Mr. R. G. Brook; "Modern Methods of Structural Steel Production," by Mr. C. Hulme; "The Composite Excentric," by Mr. W. H. Evans. 6.45 p.m.

Institution of Municipal and County Engineers.—Meeting of the Metropolitan District, to be held at the Institution's Offices, 84, Eccleston-square, London, S.W. 1. "The Future of the Institution," by Mr. R. G. Baxter. 6.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. Howard Lecture, "Oil Engine Traction," Lecture III., by Mr. Alan E. L. Chorlton. 8 p.m.

TUESDAY, MARCH 22ND.

Institution of Electrical Engineers: London Students' Section.—Presidential address, "Starting Up," by Mr. J. M. Donaldson. 6.15 p.m.

Institution of Electrical Engineers: North Midland Centre.—At the Hotel Metropole, Leeds. Discussion on "The Training of Electrical Engineers," opened by Professor E. L. E. Wheatcroft. 7 p.m.

Institution of Electrical Engineers: Scottish Centre.—North British Station Hotel, Edinburgh. "Commercial Cooking by Electricity," by Dr. T. Settle. 7 p.m.

Institution of Engineers and Shipbuilders in Scotland.—Elmbank-crescent, Glasgow, C. 2. Discussion, "Propelling Machinery for Cargo Vessels," 7.30 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Structures of Zirconium Steel," by Dr. C. Sykes. 7.30 p.m.

WEDNESDAY, MARCH 23RD.

Institution of Automobile Engineers.—Hotel Metropole, King-street, Leeds. "The Possibilities of the Unorthodox," by Mr. Maurice Platt. 7.15 p.m.

Institution of Automobile Engineers.—At the Engineers' Club, Manchester. "Some Problems Connected with High-compression-ignition Engine Development," by Mr. C. B. Dicksee. 7 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Studies in Radio Transmission," by Mr. T. L. Eckersley. 6 p.m.

Institution of Municipal and County Engineers.—Meeting of the Northern Irish District at Ballymena. Meet at the Town Hall, Ballymena, 3 p.m.

THURSDAY, MARCH 24TH.

Institution of Structural Engineers: Yorkshire Branch.—At the Hotel Metropole, Leeds. "Pile Driving by the West's Rotinoff System," by Mr. A. G. Rotinoff. 7 p.m.

WEDNESDAY, MARCH 30TH.

Newcomen Society.—At Prince Henry's Room, 17, Fleet street, E.C. 4. "Roman Mining in Britain," by Mr. G. Clemen Whittick. 5.30 p.m.

THURSDAY, MARCH 31ST.

Institute of Marine Engineers.—The Minories, E.C. 3. Lecture, "The Salvage of ex-German War Vessels at Scapa Flow," by Mr. E. F. Cox. 7 p.m.

Institution of Structural Engineers.—10, Upper Belgrave-street, S.W. 1. "Modern Constructional Practice in Sewerage and Sewage Disposal," by Mr. A. H. S. Waters. 6.30 p.m.

FRIDAY, APRIL 1ST.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Development in Electrically Welded Fabrication," by Mr. E. P. S. Gardner. 7.30 p.m.

Manchester Association of Engineers.—St. John-street Chambers, Deansgate, Manchester. "The Lay-out of Machines and Small Tools for Economical Production," by Mr. W. Core. This meeting takes the place of that announced for March 25th.

MONDAY, APRIL 4TH.

Engineers' German Circle (Deutscher Ingenieurzirkel).—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. "Ein neuzeitliches Kesselsystem nach dem Zwangumwals-Verfahren, System La Mont" ("A Modern Steam Boiler Construction with Forced Circulation, on the La Mont System"). The lecture will be illustrated with lantern slides. By Herr Dr.-Ing. A. Th. Herpen. 6 p.m.

WEDNESDAY, APRIL 6TH.

Institution of Mechanical Engineers: North-Eastern Branch.—Mining Institute, Neville Hall, Newcastle-upon-Tyne. "Industrial Conditions in Russia," by Mr. John Fearn. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "Light Sensitive Cells in the Service of Man," by Dr. F. H. Constable. 8 p.m.

Society of Glass Technology.—In the Science Museum, South Kensington. "Statistical Methods of Handling Test Results, with Special Reference to the Testing of Glassware." The discussion will be opened by Mr. Bernard P. Dudding. 7.30 p.m.

FRIDAY, APRIL 8TH.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Joint Meeting of the Meter and Instrument Section and the Wireless Section. "Some Acoustic and Telephone Measurements," by Mr. H. R. Harbottle. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Informal meeting. Discussion, "Training for Management," introduced by Mr. T. G. Rose. 7 p.m.

Institution of Mechanical Engineers: Midland Branch, Graduates' Section.—Chamber of Commerce, New-street, Birmingham. "Bridge Construction," by Dr. C. H. Shirley Smith. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "The Design and Manufacture of Taps, with Notes on Screwing Dies," by Mr. W. Wood. 7.30 p.m.

FRIDAY, APRIL 15TH.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Notes on Rocket Propulsion," by Dr. Herbert Chatley. 7.30 p.m.

FRIDAY, APRIL 22ND.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, Westminster, S.W. 1. "The Film Lubrication of the Journal Bearing," by Messrs. R. O. Boswall and J. C. Brierley. 6 p.m.

TUESDAY, JULY 5TH, TO SATURDAY, JULY 9TH.

Royal Agricultural Society of England.—Royal Show at Southampton.

Beyer-Garratt Locomotives.—We have sometimes commented upon the established fact that whilst many foreign firms issue bulletins and catalogues in English, few English firms consider it worth while to issue similar publications in foreign languages. On this account we are particularly interested in a recent publication of Beyer, Peacock and Co., Ltd., which originally appeared in English, but has now been reproduced facsimile, save in language, in French. It reviews the development of the Garratt locomotive, giving particular attention to the progress made during the past ten years, and is very liberally illustrated. Turning over the pages, we are struck by the great variety of modifications of the parent type and its wide expansion amongst the railways of the world—some hardly known, even by name. Besides general dimensions of the engines illustrated, notes about the services they are performing are given.

The Institution of Mechanical Engineers: Graduates' Section.—The Graduates' Section of the Institution of Mechanical Engineers spent a busy week-end between Friday, March 11th, and Monday, March 14th. The annual dinner was held at St. Ermin's Restaurant on Friday night, and although the numbers present were smaller than in previous years—possibly a result of the prevailing depression—the evening was very pleasantly spent. The President of the Institution was among the guests, and in reply to the toast of "The Institution" encouraged youth to persevere in whatever tasks it had in hand. The following day was spent by the graduates in a visit to the works of W. H. Allen, Sons and Co., Ltd., at Bedford, and the London Brick Company and Forders, Ltd. On the Monday, Dr. W. H. Hatfield presented the annual lecture, entitled "The Strength and Behaviour of Steels at High Temperatures." The lucidity of presentation was much appreciated, and those who attended the lecture went away with a very much clearer idea of what work was being done on this subject and what the results of researches to date had revealed. Altogether it was a very enjoyable week-end.

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